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A PAIR OF ELSEYA SP.

This species is found in the Manning River drainage of coastal NSW. The courtship and eventual mating of these two shortnecks continued over a eight hour period, during which motionless poses, at times as long as 30 minutes, took place by both sexes.

Photo J. Cann

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SEASONAL AGGREGATION BEHAVIOUR IN A MIXED POPULATION OF LEGLESS LIZARDS, *DELMA AUSTRALIS* AND *D. FRASERI*

Brian Bush, P.O. Box 192, Esperance, W.A.

ABSTRACT

Large numbers of *Delma australis* Kluge and *D. fraseri* Gray aggregate at a site near Esperance, Western Australia during the winter months. With the onset of spring they disperse over a much larger area, and return to the aggregation site in the following autumn. Maximum concentration/aggregation occurs in June for both species. Total dispersion occurs from December to March in *D. australis*, and November to January in *D. fraseri*. The dispersion is not random, but involves a westerly drift by most of the population to an alternative habitat which is suitable for summer occupation. It is suggested that this seasonal migration is behaviour of recent origin caused by the changes to the habitat that occurred when this area was largely cleared for agricultural use.

INTRODUCTION

Although there are many accounts of Australian snakes being found in winter aggregations, very little published material is available on this behaviour in Australian lizards. Lizards that do tend to congregate at the one site are the habitat-specific species i.e. the saxatile agamids, gekkonids and scincids. Apart from some seasonal fluctuation of population numbers in at least one habitat-specific agamid (Bradshaw, 1971), most will be found occupying the same site throughout the year. The present study is a record of aggregation in two species of lizards, and it also shows their ability to persist in or adapt to an altered environment if conditions are right.

THE STUDY AREA

Situated 65 kilometres west of Esperance in Lat. 33°44'S, Long. 121°17'E it is about 20 hectares in extent. Seventy percent of the area has been cleared for agricultural use and is undulating grassland; the remainder is coastal scrub/heath with the dominant vegetation being chittich *(Lambertia inermis)*, stunted mallee *(Eucalyptus spp.)* and munji *(Nuytsia floribunda)* interspersed with blackboy *(Xanthorrhoea preissii)* above various low scrub species. Monthly rainfall and mean temperatures are shown in Figure 3.

The aggregation site comprises a relic windrow of spongolite stones and mallee roots that passes north to south over the crest of a small hill. It is on the grassland about 100m east of the undisturbed heath and is 150m in length. The substrate here consists of shallow greyish sands (depth to 5cm) overlying brownish clay.

MATERIALS AND METHODS

The study area was visited once each calendar month over a 2 year period to record the location of each lizard found. Apart from a small sample retained for examination, all were released at the site of collection after measurements of snout-vent and total length were obtained. Collecting was done by hand, whilst a garden rake was used to locate individuals amongst leaf-litter. During the dry summer months the substrate was examined for shrinkage fissures that may have allowed the lizards access into the subsoil

but none were found.

Rainfall was recorded with a conventional raingauge at a point 2km east of the study site. Mean monthly temperatures were supplied by the Dept. of Meteorology, Esperance.

Estimates of population densities used here are the result of collection data compiled for several separate 1ha plots (3 plots visited on two occasions each in the study area, and 5 plots elsewhere). These data were collected in summer at the completion of the 2 year survey.

RESULTS AND DISCUSSION

Table 1 lists the reptile species and months these were found at or near the aggregation site. *D. australis* and *D. fraseri* were the most abundant species through the winter months followed by *Drysdalia coronata,* although the latter was much more widespread over the study area at all times. No other species displayed the observed aggregation.

The following discussion is divided into 4 sections: (1) the aggregation site, and why this occurs here; (2) stimuli; (3) the direction of dispersion; and (4) benefits of this behaviour, with notes on seasonal population densities.

In the present study the aggregation site is the only site within the study area that has all of the following characters that could be deemed to be suitable for the observed behaviour. These are high ground which would allow good drainage of seasonal rainfall; much of it has a northern aspect, therefore maximum exposure to the sun and protection from harsh south winds; and adequate cover in the form of stones and mallee roots.

The proximity of this site to the undisturbed heath appears an important factor concerning its selection. There are similar sites located further east, and a greater distance from the heath, but few pygopodids were found occupying these sites. *D. australis* and *D. fraseri* display a dislike for unvegetated areas (Bush, 1981). As a move to the aggregation site occurs in autumn when there is very little vegetation remaining on the grassland any individual attempting to reach the more easterly sites would have to spend much longer periods on open ground.

Stimuli — Two environmental factors evident are temperature and rainfall. There was an increase in population size at the aggregation site during January corresponding to a comparatively high monthly rainfall (see Fig. 3). Maximum aggregation was recorded in the coldest months (May to August). The only factor consistent with both periods is the high rainfall. I have found this to influence to some extent the degree of activity in the diurnal reptiles of this region i.e. a reduction in activity while overcast and raining, and an increase immediately it has ceased and the cloud has cleared.

The direction of dispersion (Fig. 2) — In the spring when the population disperses from the aggregation site, that site and the surrounding grassland undergoes a seasonal transformation; the annual grasses introduced as pasture have produced seeds and are dying off. The dispersal, which would reduce inter- and intra-specific competition, is also an emigration from an unsuitable summer habitat.

The heath, to the west, is the observed destination of the population and the direction of the initial dispersal is between north-west and south-west (see Fig. 2). Both these directions are downhill from the aggregation site, whereas to the west is comparatively level ground. One entirely speculative explanation is that the reduction in day-length results in a move to high ground and an increase in day-length results in a move to low ground.

Seasonal fluctuation of population density and related benefits — Included in Table 2 are estimates of population densities used to determine the theoretical distribution of the aggregating population during the summer dispersal. These densities are comparable with those recorded at other areas of undisturbed heath nearby (5 to 15km from study area) suggesting consistent distribution of the two species in local heath habitats.

The sparse distribution of these pygopodids while dispersed would limit male-female encounters. With the winter aggregation of the population, optimum conditions for males to locate females would occur during the initial stage of the dispersal. The possible relationship between aggregation behaviour and reproduction is supported by the snout-

vent lengths (i.e. maturity) of the aggregated individuals (Fig. 4). Adults account for 83% in *australis* and 75% in *fraseri*.

Two questions that arise if the aggregation is reproduction linked are: (1) are both species, throughout their range, divided into breeding groups that have a 'home range' with defined boundaries? And (2) are communal egg-laying sites the result of this breeding-group situation?

CONCLUSION

The aggregation observed during the present study may or may not be typical behaviour throughout these species' range. Both are common and widespread in this region, although I have been unable to locate other comparable examples of aggregations in the undisturbed heath. Therefore, on the data available to date, it is believed to be an isolated phenomonon caused by two factors: (1) an instinctive move by individual lizards to a suitable elevated site for the duration of the wet winter months; and (2) the clearing of the natural vegetation has reduced the size of suitable elevated areas which can be used by this population, thus causing such a concentrated aggregation at this site.

The direction of general dispersal is probably a direct response to land clearing.

ACKNOWLEDGEMENTS

I am grateful for the assistance of Bob Baird and Murray Pfitzner in recording the climatic data for the duration of this study. Especial thanks go to Rick Shine, Harry Ehmann and Gerry Swan for suggestions and criticism that were invaluable in the preparation of this manuscript. Accursed with a meandering mind I also thank H.E. for keeping me on the 'straight and narrow'.

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SPECIES	MONTH											
	J	F	M	A	M	J	J	A	S	O	N	D
Aprasia striolata									*			
Delma australis	*			*	*	*	*	*	*	*	*	
Delma fraseri	*	*	*	*	*	*	*	*	*	*		
Hemiergis peronii	*	*	*	*	*	*	*	*	*	*	*	*
Leiolopisma trilineatum	*	*		*	*	*	*	*		*	*	*
Menetia greyii	*	*	*			*	*		*	*	*	
Drysdalia coronata	*	*	*	*	*	*	*	*	*	*	*	*
Echiopsis curta						*						

Table 1. Species recorded at aggregation site.

	A	B	C
D. australis	22	3.5/ha (N 6, 0-6)	6.3ha
elsewhere		3.2/ha (N 5, 1-5)	
D. fraseri	13	1.5/ha (N 6, 0-3)	8.7ha
elsewhere		1.8/ha (N 5, 0-4)	

A — Peak population numbers at aggregation site (recorded in June).

B — Population density estimated while dispersed.

C — Possible population distribution while dispersed (A divided by B).

Table 2. Estimates of population density of the study population, including estimates from elsewhere (5-15km from study area), with theoretical dispersal area.

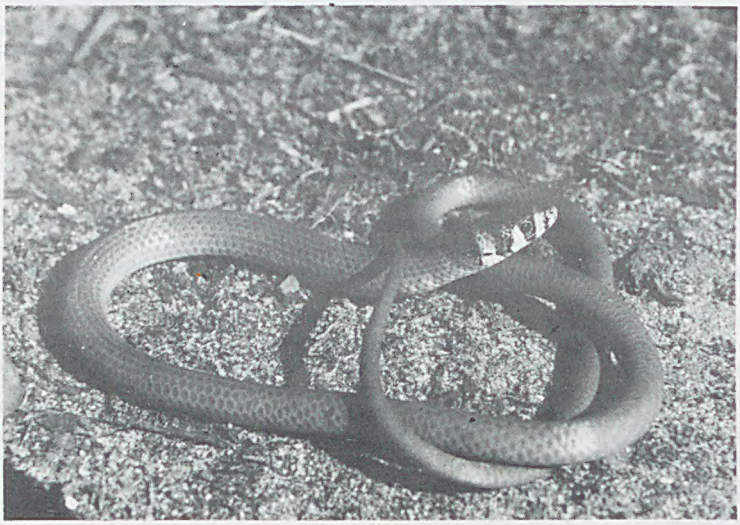

Figure 1. *Delma fraseri*. The larger of the two species of legless lizards that shared the aggregation site during the winter months.

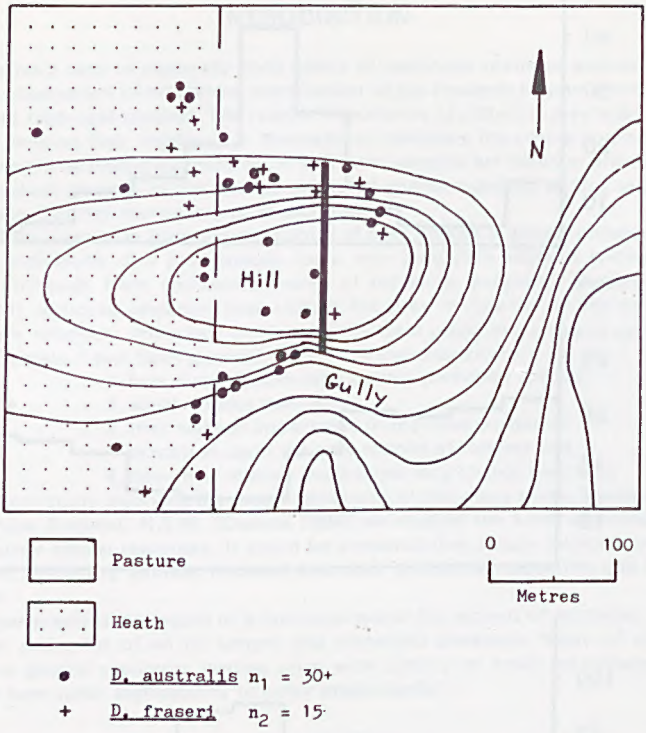

Figure 2. Map of study area showing location of legless lizards relative to aggregation site after dispersal (Oct. - Mar.). Plotted from data collected over two consecutive seasons. Note that few lizards dispersed to the east of the aggregation site.

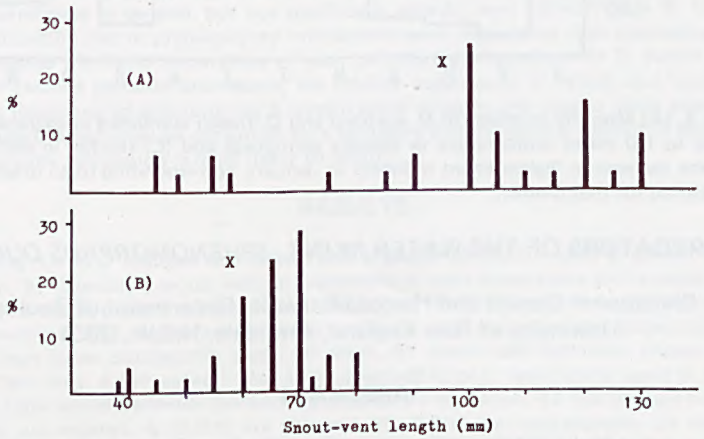

Figure 4. Histogram of S-V L ratios for aggregated population of (A) *Delma fraseri* and (B) *D. australis*. That portion to the right of X is considered sexually mature. Note that each species occupies a separate size range and that the majority of the population is to the right of X.

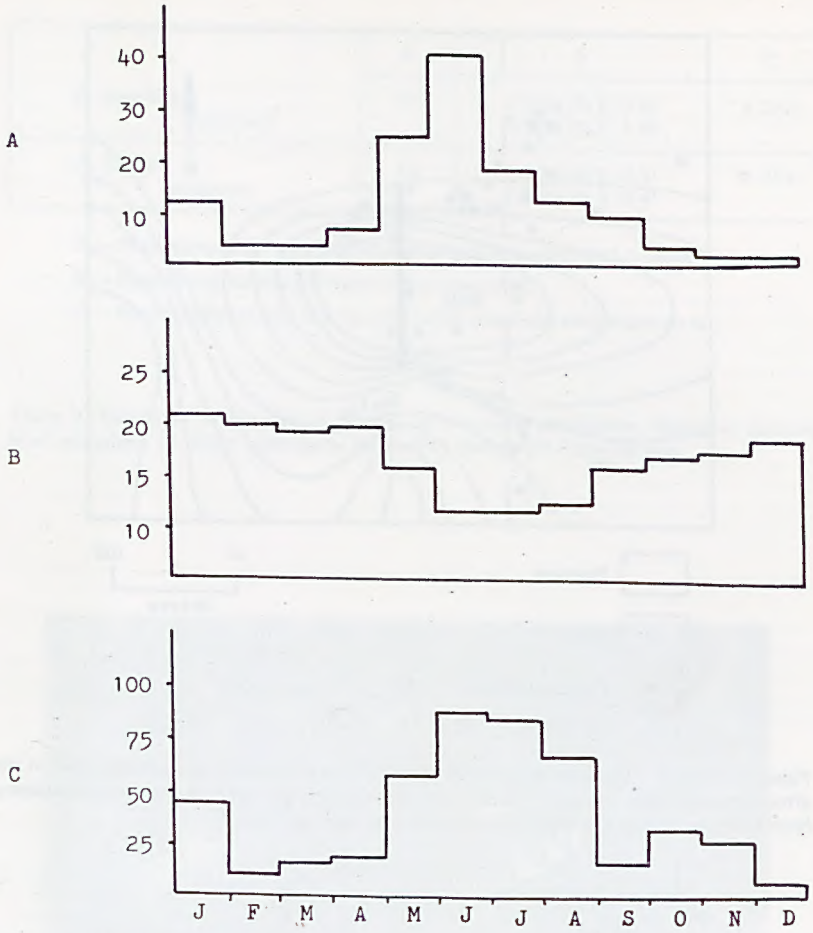

Figure 3. (A) Monthly numbers of *D. australis* and *D. fraseri* combined at aggregation site relative to (B) mean temperature in degrees centigrade and (C) rainfall in millimetres. Note the increase in legless lizard numbers in January corresponding to an unseasonally high rainfall for that month.

PREDATORS OF THE WATER SKINK, *SPHENOMORPHUS QUOYII.*

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ABSTRACT

The water skink, *Sphenomorphus quoyii* on the New England tablelands of New South Wales has 102 potential predators. The majority are birds, the remainder include mammals, reptiles, fish and invertebrates, 14% of the potential predators are believed to have a significant impact, and most probably catch the lizards on land. Juveniles are probably subjected to higher predation rates than adults.

INTRODUCTION

It is relatively easy to study the food habits of particular predator species by fortuitous direct observation of predation, examination of gut contents (dissection or stomach flushing) and from scat analysis. The relative importance of different prey species can be assessed by tallying their incidence in stomachs or indicating the proportion of the total volume or weight of food they make up. If sufficient samples are taken at different times of year, seasonal changes in diet can be evaluated and ontogenetic and/or sexual comparisons made. The literature abounds in such studies.

By contrast, predation from the standpoint of prey species is almost unrecorded. One can watch individuals of a prey species for a very long time without witnessing any predation. Although from stomach contents of particular predatory species, one can ascertain that particular predators may include the prey in question in the diet or even that they are relatively important predators, the total predatory pressure upon a prey species has seldom if ever been assessed. Factors of importance are:

1. how many species prey upon a particular species,
2. which species they are,
3. their relative importance in the total burden of predation upon the prey species of interest and,
4. how their relative importance may change over time.

During a recent study involving the escape behaviour of the water skink, *Sphenomorphus quoyii* in New England, N.S.W. (Daniels 1984) we studied the kinds of predators that might stimulate escape responses. It could be expected that escape tactics depend upon the kinds of predatory animals involved and their perceptive capacities and modes of locomotion.

This paper presents the results of a literature search for records of predation upon the water skink and a list of all its known and suspected predators. Many of the species involved are general predators feeding on a wide variety of small vertebrates, so this search may have wider applicability to other small lizards.

METHODS

The carnivores recorded as consuming lizards were listed, indicating those known specifically to eat *S. quoyii* by an asterisk (Table 1). Those carnivores known to consume small vertebrates in general, but not specifically lizards, were added (Table 2). Original observations on diet or predator-prey interactions were used rather than secondary texts. We evaluated the likely importance of each carnivore as a predator on *S. quoyii* on the basis of ranking predator abundance, the relative importance of lizards as a food item, and the likelihood of encountering *S. quoyii* while foraging. We suggest likely size ranges of *S. quoyii* which may be consumed by a carnivore and the general habitat in which the predator-prey interaction is most likely to occur.

RESULTS

Tables 1 and 2 indicate the known and probable predators upon *S. quoyii* in New England, by taxonomic group with an assessment of their importance to the water skink, the site in which predation most likely occurs and the size range of water skinks likely to be involved. 102 species are potential predators of *S. quoyii* at least occasionally and for at least some ontogenetic stage. Of these, 51 species are definitely known to eat lizards but only 4 (all snakes) have been observed to prey specifically upon *S. quoyii.* Of the total actual potential predators 9 (8.8%) are mammals, 62 (60.8%) are birds, 15 (14.7%) are reptiles, 6 (5.9%) are fish and 10 (9.8%) are invertebrates. Of those 51 species definitely known to eat lizards, 7 (13.7%) are mammals, 27 (52.9%) are birds, 12 (23.5%) are reptiles, 1 (2.0%) is a fish and 4 (7.8%) are invertebrates.

15 (14.7%) of the actual and potential predators listed are likely to be of major importance to *S. quoyii*, 67 (65.7%) are of minor importance and 20 (19.6%) are relatively unimportant.

The water skink spends much of its time on land in the vicinity of water and uses the water as a means of escape, either by diving or swimming; when inactive it seeks shelter in burrows or under objects (Daniels 1984). The habits of its presumed predators are such that it is considered that 55 (53.9%) would be most likely to capture *S. quoyii* on land, 12 (11.8%) either on land or in the water, 28 (27.5%) in the water and 7 (6.9%) underground.

62 species or 60.8% of the presumed predators take prey that encompasses the entire size range of *S. quoyii*. The remaining species (40 or 39.2%) are too small to take adult *S. quoyii* and if they prey on the species, they probably restrict themselves to the younger (smaller) individuals.

DISCUSSION

There are a number of factors that influence the importance of a predator upon its prey. A predator may preferentially select or avoid particular species of prey. A prey species may be more effective in escaping from or defending itself against different predatory species. Different predator-prey combinations may overlap in microhabitats or activity periods to different degrees and thus prey accessability may vary. Intensity of predation may depend on the densities of predators and of prey. Data are not available for evaluating these factors for *S. quoyii* and its presumed predators. Even without such information, were the incidence of feeding of each species of presumed predator upon *S. quoyii* in the field known in detail, (including seasonal and ontogenetic changes and sexual differences) the relative importance of the various species could be more accurately assessed. It is unlikely that such complete knowledge will ever be at hand and interpretations must be cautious and speculative, resting on rather circumstantial, imprecise evidence. However, if the presumed predators do in fact prey on *S. quoyii* and in the way suggested by their habits and sizes (Tables 1 and 2), then it seems that *S. quoyii* has a large number of species that prey upon it, most of which are birds, but only a small proportion of which are important. Juveniles are probably subjected to more intense predation than are adults because in addition to a wide range of predators that can take all sizes of *S. quoyii* there are additional ones that probably prey on juveniles but not adults.

Given the tentative nature of these interpretations they are presented more as hypotheses than as conclusions. However, they can be used as an heuristic context against which the known escape behaviour of *S. quoyii* can be viewed. This species is wary and frequently uses water as a escape route and adults are more adept in their use of the aquatic medium than are juveniles (Daniels 1984). It seems that the escape behaviour is appropriate to the prevalent type of predator and that juveniles are more susceptible to predation than adults. A fruitful line of research would be to ascertain whether *S. quoyii* displays different escape responses to different kinds of potential predators, e.g. avian predators versus snakes.

It is clear that the present analyses suffer from lack of pertinent data of the type that accumulates only slowly and with laborious effort. The same would apply to almost any other species for which an assessment of its predators were attempted. There is a clear need for descriptive, even ancedotal data, on feeding habits of animals. Descriptive studies tend to be denigrated and such a narrow, restrictive stance, tends to cut off the supply of those basic natural history observations which are the fuel required for the generation of new hypotheses. There is a very real and important role for the professional and amateur herpetologist in accumulating descriptive information and swelling the store of basic factual data available. We should use all valid approaches to scientific study and not restrict ourselves categorically to any particular methodological fad, regardless of how fruitful or sophisticated it may be.

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The references are listed chronologically with the prefixed numbers referring to the reference numbers in Tables 1 and 2.

No.	Source	No.	Source	No.	Source
1	Cleland (1911)	25	Pianka (1970)	49	Houston (1978)
2	McKeown (1934a)	26	Green (1972)	50	Jackson (1978)
3	McKeown (1934b)	27	Pengilley (1972)	51	Lake (1978)
4	Gilbert (1935)	28	Coman (1973)	52	Woollard **et al.** (1978)
5	Lea and Gray (1935a)	29	Houston (1973)	53	Beumer (1979)
6	Lea and Gray (1935b)	30	Morris (1973)	54	Bustard (1979)
7	Lea and Gray (1936)	31	Rose (1973)	55	Jenkins & Bartell (1979)
8	Fleay (1937)	32	Rowley & Vestjens (1973)	56	McPhee (1979)
9	Serventy (1938)	33	Ryan and Croft (1974)	57	Miller (1979)
10	McKeown (1943)	34	Slater (1974)	58	Morton & Martin (1979)
11	McKeown (1944)	35	Vestjens & Carrick (1974)	59	Olsen **et al.** (1979)
12	Butcher (1945)	36	Bell (1975)	60	Brooker & Ridpath (1980)
13	Serventy (1947)	37	Brunner **et al.** (1975)	61	Hall (1980)
14	Fleay (1949)	38	Davis (1975)	62	Debus (1981)
15	Main and Main (1956)	39	Vestjens (1975a)	63	De Rebeira (1981)
16	Butler & Main (1959)	40	Vestjens (1975b)	64	Ford and Bell (1981)
17	McMillan (1961)	41	Main (1976)	65	Jones & Coman (1981)
18	Nash (1962)	42	Pianka & Pianka (1976)	66	Pidgeon (1981)
19	McIntosh (1963)	43	Tyler (1976)	67	Valente (1981)
20	Binns (1966)	44	Shine (1977)	68	Tilley (1982)
21	Bustard (1968a)	45	Vestjens (1977)	69	McFarland (1982)
22	Bustard (1969)	46	Whitehouse (1977)	70	Strahan (1983)
23	Butler (1970)	47	Cann (1978)	71	Baker-Gabb (1984)
24	Leopold & Wolfe (1970)	48	Croft and Hone (1978)	72	Debus (1984)
				73	McKilligan (1984)

Table 1. Predators sympatric with *Sphenomorphus quoyii* and known to consume lizards.
* indicates species which are known to eat *S. quoyii.*

Potential Predator		Status of Predator	Likely site of Predation	Size of *S. quoyii* likely to be consumed.	Reference No. (See Literature Cited)
Common Name	Scientific Name				
Mammalia					
Feral Cat	*Felis catus*	major	Terrestrial	all	65
Dingo	*Canis familiaris*	minor	Terrestrial	all	42, 46
Red Fox	*Vulpes vulpes*	minor	Terrestrial	all	19, 28, 33, 37, 42, 48
Yellow-Footed Antechinus	*Antechinus flavipes*	minor	Terrestrial	juveniles	14
Swainson's Antechinus	*A. swainsonii*	minor	Terrestrial	juveniles	26
Quoll	*Dasyurus maculatus*	minor	Terrestrial	all	70
Brush-Tailed Phascogale	*Phascogale tapoatafa*	minor	Terrestrial	all	70
Aves					
Raven	*Corvus coronoides*	major	Terrestrial	all	7, 21, 22, 32, 64
Crow	*C. orru*	major	Terrestrial	all	32
Grey Butcherbird	*Cracticus torquatus*	major	Terrestrial	subadult/juv.	7, 64
Sacred Kingfisher	*Halcyon sancta*	major	Terrestrial/Aquatic	subadult/juv.	6, 31
Kookaburra	*Dacelo gigas*	major	Terrestrial	all	6, 13, 64
White-Faced Heron	*Ardea novaehollandiae*	major	Aquatic	all	5
Pied Currawong	*Strepera graculina*	major	Terrestrial	all	7, 31
Grey Currawong	*Strepera versicolor*	major	under rocks	all	69
Nankeen Kestrel	*Falco cenchroides*	major	Terrestrial	all	5, 31, 59, 71
Grey Shrike-Thrush	*Colluricincla harmonica*	major	Terrestrial	all	6
Pied Butcherbird	*Cracticus nigrolaris*	minor	Terrestrial	all	7, 21, 22
Red-Backed Kingfisher	*Halcyon pyrrhopygia*	minor	Terrestrial/Aquatic	subadult/juv.	6
Brown Goshawk	*Accipiter fasciatus*	minor	Terrestrial	all	31, 64, 71
Spotted Harrier	*Circus assimilis*	minor	Terrestrial	all	5, 71
Black-Shouldered Kite	*Elanus notatus*	minor	Terrestrial	subadult/juv.	3, 5, 62, 64
Little Eagle	*Haliaetus morphnoides*	minor	Terrestrial	all	5, 6, 71, 72
Wedge-Tailed Eagle	*Aquila audax*	minor	Terrestrial	all	3, 5, 24, 60, 62, 71

Brown Falcon	*Falco berigora*	minor	Terrestrial	all	5, 31, 64, 71
Barn Owl	*Tyto alba*	minor	Terrestrial	all	58, 67
Tawny Frogmouth	*Podargus strigoides*	minor	Terrestrial	all	21, 22
Magpie	*Gymnorhina tibicen*	minor	Terrestrial	subadult/juv.	35
Black-Faced Cockoo-Shrike	*Coracina novaehollandiae*	minor	Terrestrial	all	6
Cattle Egret	*Ardeola ibis*	minor	Terrestrial	all	73
Whistling Kite	*Haliaster sphenurus*	minor	Terrestrial	all	45, 64, 71
Magpie-Lark	*Grallina cyanoleuca*	Very minor	Terrestrial	juveniles	20, 31
House Sparrow	*Passer domesticus*	Very minor	Terrestrial	juveniles	20
Striated Pardalote	*Pardalotus ornatus*	Very minor	Terrestrial	juveniles	36
Reptilia					
*Black Snake	*Pseudechis porphyriacus*	major	Terrestrial/Aquatic	all	4, 8, 44
*Brown Snake	*Pseudonaja textilis*	major	Terrestrial	all	27, 44
*Copperhead	*Austrelaps superba*	minor	Terrestrial	all	8, 44
Swamp Snake	*Hemiaspis signata*	minor	Terrestrial	juveniles	44
White-Lipped Snake	*Drysdalia coronoides*	minor	Terrestrial	juveniles	27
*Tiger Snake	*Notechis scutatus*	minor	Terrestrial	all	8, 44
Carpet Python	*Morelia spilotes*	minor	Terrestrial	all	29
Goulds Monitor	*Varanus gouldii*	minor	Terrestrial	all	21, 22, 25, 42
Lace Monitor	*V. varius*	minor	Terrestrial	all	21, 22
Bearded Dragon	*Amphibolurus barbatus*	minor	Terrestrial	juveniles	29, 49, 55, 56
Legless Lizard	*Lialis burtonis*	minor	Terrestrial	juveniles	21, 42, 54, 56
Tree Skink	*Egernia striolata*	minor	Terrestrial	juveniles	21
Pisces					
Rainbow Trout	*Salmo gardneri*	minor	Aquatic	juveniles	2, 66, Pidgeon, pers. comm.
Invertebrata					
Centipede	*Scolopendromorpha*	major	Fossorial	juveniles	23
Funnel-Web Spiders	*Macrothelinae*	minor	Fossorial	juveniles	15, 41
Wolf Spiders	*Lycosa sp.*	minor	Fossorial	juveniles	17
Red-Back Spiders	*Latrodectus hasseltii*	minor	Fossorial	juveniles	10, 63

Table 2. Predators sympatric with *Sphenomorphus quoyii*, known to eat small vertebrates generally, but not known specifically to eat lizards.

Potential Predator		Status of Predator	Likely site of Predation Attempt.	Size of *S. quoyii* likely to be consumed.	Reference No. (See Literature Cited)
Common Name	Scientific Name				
Mammalia					
Stuarts Antechinus	*Antechinus stuartii*	minor	Terrestrial	juveniles	61
Water Rat	*Hydromys crysogaster*	minor	Terrestrial&Aquatic	all	52
Aves					
Azure Kingfisher	*Ceyx azureus*	major(?)	Terrestrial/Aquatic	subadult/juv.	34
Pied Cormorant	*Phalacrocorax varius*	minor	Aquatic	all	9, 11
Little Pied Cormorant	*P. valanoleucos*	minor	Aquatic	all	5, 9, 11
Black Cormorant	*P. carbo*	minor	Aquatic	all	1, 9, 11, 31
Little Black Cormorant	*P. sulcirostris*	minor	Aquatic	all	3, 5, 11, 57
Little Egret	*Egretta garzetta*	minor	Aquatic	all	5
White Egret	*E. alba*	minor	Aquatic	all	34
Plumed Egret	*E. intermedia*	minor	Aquatic	all	34
Royal Spoonbill	*Platalea regia*	minor	Aquatic	juveniles	11, 40
Yellow-Billed Spoonbill	*P. flavipes*	minor	Aquatic	juveniles	11, 40
Pelican	*Pelecanus conspicillatus*	minor	Aquatic	all	34
White-Necked Heron	*Ardea pacifica*	minor	Terrestrial/Aquatic	all	34
White Ibis	*Threskiornis molucca*	minor	Aquatic	all	3, 30, 45
Straw-Necked Ibis	*T. spinicollis*	minor	Aquatic	all	34
Little Grebe	*Podiceps novaehollandiae*	minor	Aquatic	all	34
Eastern Whipbird	*Psophodes olivaceus*	minor	Terrestrial	subadult/juv.	6
Nankeen Night Heron	*Nycticorax caledonicus*	minor	Terrestrial/Aquatic	all	34
Brown Bittern	*Botaurus poiciloptilus*	minor	Terrestrial/Aquatic	all	34
Darter	*Anhinga melanogaster*	minor	Aquatic	all	11, 39
Swamp Harrier	*Circus approximans*	minor	Terrestrial	all	45
Collared Sparrowhawk	*Accipiter cirrocephalus*	minor	Terrestrial	all	5
Little Falcon	*Falco longipennis*	minor	Terrestrial	all	3, 5

Peregrine Falcon	*F. peregrinus*	minor	Terrestrial	all	31, 71
Silver Gull	*Larus novaehollandiae*	Very minor	Terrestrial/Aquatic	all	5,
Little Bittern	*Ixobrychus minutus*	Very minor	Terrestrial/Aquatic	all	34
White-Breasted Sea-Eagle	*Haliaetus leucogaster*	Very minor	Terrestrial/Aquatic	all	31
Masked Owl	*Tyto novaehollandiae*	Very minor	Terrestrial	all	5
Sooty Owl	*T. tenebricosa*	Very minor	Terrestrial	all	34
Boobook Owl	*Ninox novaeseelandiae*	Very minor	Terrestrial	all	5
Barking Owl	*N. connivens*	Very minor	Terrestrial	all	34
Powerful Owl	*N. strenua*	Very minor	Terrestrial	all	1, 31, 68
Owlet Nightjar	*Aegotheles cristatus*	Very minor	Terrestrial	all	34
Black Swan	*Cygnus atratus*	Very minor	Aquatic	all	34
Swamp Hen	*Porphyrio porphyrio*	Very minor	Aquatic	juveniles	34
Coot	*Fulica atra*	Very minor	Aquatic	juveniles	34
Reptilia					
Water Dragon	*Physignathus lesueurii*	minor	Terrestrial/Aquatic	all	55, 56
Long-Necked Tortoise	*Chelodina longicollis*	Very minor	Aquatic	subadult/juv.	29, 47
Short-Necked Tortoise	*Emydura macquarii*	Very minor	Aquatic	subadult/juv.	29, 47
Pisces					
Short-Finned Eel	*Anguilla australis*	minor	Aquatic	subadult/juv.	53
Long-Finned Eel	*A. reinhardtii*	minor	Aquatic	subadult/juv.	53
Brown Trout	*Salmo trutta*	minor	Aquatic	subadult/juv.	2, 12, 50
Redfin	*Perca fluviatilis*	minor	Aquatic	subadult/juv.	12
Catfish	*Tandanus tandanus*	Very minor	Aquatic	subadult/juv.	38, 51
Invertebrata					
Trap-Door Spiders	*Ctenizidae*	minor	Fossorial	juveniles	10, 16
Huntsman Spiders	*Sparassidae*	minor	Fossorial	juveniles	41
Water Spiders	*Dolomedes sp.*	minor	Aquatic	juveniles	10, 43
Water Spiders	*Desis marina*	minor	Aquatic	juveniles	10, 43
Praying Mantis	*Mantidae*	Very minor	Terrestrial	juveniles	18, 43
Orb Spider	*Epeira productus*	Very minor	Terrestrial	juveniles	10

SOME NOTES ON THE HABITS OF THE LITTLE WHIP SNAKE, *UNECHIS FLAGELLUM.*

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ABSTRACT

This article provides information on behaviour of the Little Whip Snake, *Unechis flagellum,* in terms of aggregation, breeding, activity periods, feeding, predation and defence.

Unechis flagellum was often found under cover in aggregations of two or more animals. No specimens were even found away from cover during daylight and little activity was observed in captive specimens before nightfall.

Gravid females and young were found from July to early November. One pair of captive specimens mated in May and young were born in September.

Food consists mainly of lizards but frogs are also eaten. Two captive specimens ate pink mice but no captive specimens could be induced to eat arthropods of any sort.

Observations from the field and on captive specimens over a period of 2 years were used to provide the information and theories proposed in this article.

INTRODUCTION

Unechis flagellum is a widespread species of snake in south-eastern Australia, being found from the highlands of southern New South Wales, through central and coastal Victoria to the ranges of south-eastern South Australia, (Cogger, 1983; Jenkins and Bartell, 1980). It is a common snake in the rocky, undulating regions to the north and west of Melbourne, Victoria (James, 1979).

It is surprising that this species of snake, which lives in an area of high human population, has had so little recorded of it's habits in the wild or in captivity. The most recent general works on Australian herpetofauna have shed little light on the habits of this species. "A small, secretive nocturnal snake. Rawlinson records it as feeding on small lizards and insects. Otherwise little known of habits. Viviparous." Cogger, 1983.

"Very little is known of the habits . . . has been unearthed from a depth of several centimetres in light sandy soil of gardens. The food consists of small frogs and lizards . . ." Gow, 1976.

"It is noctural in habit and may be found under rocks on well drained hillsides. It's diet consists of invertebrates and small skinks of the genera *Leiolopisma* and *Hemiergis,* which occur in similar microhabitats. The Little Whip Snake is ovoviviparous . . ." Jenkins and Bartell, 1980.

The aim of this article is to describe the habits of this small snake in more detail, both in the wild state and under captive conditions.

DESCRIPTION OF SPECIES

Cogger (1983), Gow (1976), and Jenkins and Bartell (1980) all provide similar descriptions of this species.

Mid body scales are smooth and arranged in 17 rows, we found no individuals with 15 rows during our field work.

Ventral scales number between 125-150 (Cogger, 1983). Sub caudal scales are single and number between 22 - 40. The anal scale is entire. The nasal scale contacts the preocular.

The colouration of this species is generally tan to brown dorsally with a dark base to each scale, giving the snake a reticulate appearance. The top of the head is black, extending onto the neck for several scale rows, except for a pale bar in front of the eyes. The ventral surfaces are cream to very pale orange. Many of the specimens found by us were very dark dorsally, so that the reticulate appearance was not noticable. Other dorsal colours noted by us were one brick red specimen and several bright orange specimens.

One aspect of the identification of this species which is immediately noticeable in the field is the sex of the snake. Female snakes have extremely short tails and look quite "adderish". Males have longer "normal" looking tails. It follows then that male snakes have more sub caudal scales than females and make up the higher end of the sub caudal scale number range.

MATERIALS AND METHODS

Samples of this species were examined from a variety of sites to the north and west of Melbourne, Victoria from January 1979 to March 1981. Once located, each snake was sexed, scale counts were performed and total length was measured to the nearest centimetre. The snake was then released at the capture site. This species was located while we were engaged in field surveys for the Victorian Herpetological Society under permit from the Victorian Fisheries and Wildlife Division. Under the conditions of this permit, we were not able to take specimens for dissection and hence could not ascertain feeding habits and reproductive condition by the dissection of freshly captured animals.

Both authors maintained small groups ($n = 4$, $n = 8$) of this species in captivity in order to learn more of their behaviour by observation. These snakes were housed in heated enclosures, 60 x 30 x 30 cm ($n = 4$) and 120 x 60 x 60 cm ($n = 8$), with sand and leaf litter as substrate. Cover was provided by rock slabs and flat tree bark.

HABITAT

Most of our sample sites were located in grassland areas in the volcanic plains to the north and west of Melbourne, Victoria. The country is flat to undulating and the rivers and creeks have cut deep valleys into the plain, exposing the underlying rock. The rock has weathered and cracked to provide crevices, rock on rock and rock on soil habitats.

Most of the snakes (approx. 80%) were located under large flat rocks on soil, situated on hillsides and valley sides or small rocky rises in the plain. Other snakes were found in the same areas but were sheltering in rock crevices, under fallen timber or under sheets of tin.

Two of the sites were in more "bushy" habitats, although both had abundant exposed rock lying on the ground. One of these, located in the You Yangs near Geelong, consisted of an open hilltop with scattered dense stands of regenerating *Acacia* scrub. The other site, near Euroa, consisted of dry *Eucalyptus* woodland on a rocky hillside.

The rocks under which the snakes lie are often large (90 cm dia.) and usually low and flat (between 5 - 15 cm thick). Invariably the site was well drained and although the soil under the rock may have been damp, it was never wet.

Those snakes that were found under sheet tin would usually attempt to move into deep cracks in the soil upon discovery. Once in these earth cracks, the snakes were virtually impossible to extract without injury to the snake.

ACTIVITY PERIODS

This species appears to be nocturnal in habit (Cogger, 1983; Lillywhite, 1980; Jenkins and Bartell, 1980). In captivity it leaves cover to forage about the cage soon after night falls. Little activity was noted during the day in captive specimens, although they fed readily in daylight if taken from cover. No specimens were found away from cover during daylight in the wild.

Four wild specimens were seen to be active on one night in mid March. The area where these snakes were seen hosts a large population of the small skink *Lampropholis guichenoti* that shelter under sheets of corrugated tin. It appears as though the observed snakes were moving between the sheets of tin, possibly in search of prey. The distance between the sheets of tin was, on average, 2.5 metres. The time that these activities were noted was between 20.30 and 21.30 hrs., the air temperature was 20°C, there was no moon and a very light northerly breeze.

FEEDING HABITS

Unechis flagellum has been recorded as feeding on small lizards, frogs and insects. Kinghorn (1964), Rawlinson (1980 pers. comm.) and Jenkins and Bartell (1980) record insects as prey. None of our captive specimens could be induced to take arthropods of any type. Arthropods tried included types from the areas in which the snakes were found. Examples are field crickets, slaters (wood lice) and centipedes. We even tried earthworms! It is possible that the insects recorded as gut contents in dissected specimens (Kinghorn, 1964), were in fact originally the gut contents of lizards consumed and digested by the snake; the hard parts of the insect resisting digestion by either predator.

At some sites the apparently preferred prey of this snake, small skinks, were often non existant in the area immediately adjacent to the snakes, even though a thorough search was made in the area. The closest population of skinks found near some snake populations was over 400 metres away.

Most authors agree that *Unechis flagellum* feeds on small lizards. New born snakes can predate successfully on adult *Leiolopisma entrecasteauxii* skinks. This means that even the smallest snakes can feed without resorting to insect prey.

We could not induce our captive snakes to feed on frogs, although the species has been recorded as doing so by Gow (1976). On one occasion an average sized snake was found under a flat rock, half of the snakes length wedged into a crack in the hard soil. During the process of removing the snake, it was subjected to slightly rough treatment. As a result of this rough treatment, the snake regurgitated a small frog that appeared to be a *Ranidella signifera.* The area in which the snake was found supported a large population of that frog species and no small skink lizards were found on that or any subsequent visit to the area. Other sites were noted where there were good populations of small frogs, and no small lizards on which the snakes could feed.

One prey species that was eaten by two of our captive snakes was new born house mice, *Mus musculus.* This happened on two occasions. On the first occasion, 3 new born mice were placed in the snakes cage alive. The 2 largest snakes (1♂ : 1♀) both fed, the male consuming 2 mice. On the second occasion, dead new born mice were placed in a box with live skinks before being offered to the snakes. The same large male snake fed on 1 mouse out of 4 offered. That this species of snake will occasionally feed on mice is of interest because mice are a common inhabitant of the rocky grasslands where this snake is most common.

When foraging, the snake uses it's long tongue continually and searches under and around rocks, wood and other debris which may harbour sheltering prey. Being nocturnal, the snakes probably find diurnal lizards sheltering under cover at night. In captivity, the snakes will accept freshly killed skinks as food; the dead skinks probably resemble the inactive prey normally encountered in the wild.

In captivity, our *Unechis flagellum* have eaten the following species:

Lampropholis guichenoti
L. mustelina
Leiolopisma entrecasteauxii
L. trilineata
Hemiergis decresiensis
Ctenotus robustus (juvenile)
Morethia boulengeri
Lerista bougainvillii
Mus musculus (new born)

BREEDING

It is generally agreed that *Unechis flagellum* is either viviparous or ovoviviparous, bearing 2 - 4 live young. We have found that the new born young measure 130 - 150 millimetres, which is in contrast to the 70 - 80 millimetres reported by Jenkins and Bartell (1980).

In the field, very young snakes were often found under the same rocks as adult female snakes from July through to early November. This, we believe, indicates the probable birth period for this species in southern Victoria. Gravid female snakes were also found during this period. In one case, 7 snakes were found under a single large sheet of rock; 4 were new born young, one was a thin "hollow" female (obviously the parent of the young), one was a heavy, gravid female and the last was a large adult male. These snakes were found on 12th September, 1980.

During the winter months it was usual to find this species in groups of 2 or more snakes. Generally both sexes were present under the same rock or at least adjacent rocks, usually less than 3 metres apart. On warm, sunny days in winter the snakes were quite mobile upon discovery; not at all torpid. From the above observations we have come to the conclusion that this species mates from April to July, under the cover of rocks and during daylight.

These findings from the field are supported by our breeding record in captivity. Four adult snakes (1♂ : 3♀) were being kept in a vivarium. On 19th May, 1980 the male snake was observed to be coupled with the largest female. Copulation lasted over 1 hour, but separation or precopulatory behaviour were not witnessed. 121 days later, on 19th September, 1980, 4 baby snakes were found in the cage. The sex ratio of this birth was 1:1 and all young were approximately 13.0 cm., snoutvent length, with male tails of 1.5 cm., and female tails at 1.0 cm.

Mating during winter days possibly represents a time saving strategy by this species, enabling female snakes to produce young in early to mid spring at a time when insect and small lizard populations are becoming active after winter. New born snakes have a longer period to feed and grow before the next winter than they would under a more usual mating strategy. This mating strategy also lowers the risk of predation to the adult snakes since it reduces the need to search for mates and the actual mating takes place under cover.

AGGREGATIONS

During the cooler months it was usual to find *U. flagellum* in groups of 2 or more, under a single piece of cover. Further surveys during the warmer months have shown that these aggregations are a feature of this species year round. During winter we found that 3 was the average number of snakes per rock. This figure dropped to 2 during the warmer weather. (See Fig. 1.).

The winter aggregations typically consisted of a sub-adult of either sex and a pair of adult snakes. Summer groups seemed to contain either 1 sub-adult and 1 adult female or a pair of adults in equal frequency.

The reason for these aggregations seems to be twofold. The major reason for the adult snakes is to facilitate mating over the winter period when searching for mates from rock to rock would be hazardous and energy consuming. The second reason could be one of limited "ideal" rock refuges in an area. The snakes are selective in choosing rock refuges as we have lifted hundreds of suitable looking rocks (to us) at some sites, before finding one with snakes under it.

It is interesting to note that snakes found under timber or sheet tin are usually found singly, but usually only a few metres apart.

PREDATION AND DEFENCE

Although neither author has witnessed predation on *U. flagellum* in the field, it is

hard to imagine the species as being free from predators. Certainly larger reptiles that co-inhabit the same area probably prey on *U. flagellum* occasionally. The Eastern Brown Snake, *Pseudonaja textilis*, is recorded as being a reptile feeder and *U. flagellum* would be an ideal size and shape as a meal for sub-adult Brown snakes. Marsupial mice, particularly *Sminthopsis crassicaudata*, are present in some of the sites occupied by *U. flagellum* and are potential predators. Birds of prey were common in the sites where our surveys were performed; they would be effective predators during daylight on any snakes that did leave the safety of cover.

Unechis flagellum does not prey on itself as a species. This is indicated by the frequency of aggregations containing adult and juvenile snakes.

The defence behaviour of this species is quite unusual. Upon discovery the snake will flatten itself out and form a "shallow cone with it's head at the apex" (Jenkins and Bartell, 1980). If an attempt is made to grasp the snake at this time, it will thresh around wildly and if grasped, it may bite, in contrast to the statement by Jenkins and Bartell (1980) who state "it is reluctant to bite when handled". We have found females snakes to be more likely to bite at some sites, but this may be a phenomenon of the Melbourne area.

Another apparent defence mechanism appears to be that *U. flagellum* gives off an offensive odour if handled roughly. If the odour is applied to the hands it take 1 or 2 hours to lose its effects. Whether or not this odour is effected by means of a fluid is not known by us, but we believe that it acts as a possible deterent to would-be predators. Captive snakes soon cease to release this odour, presumably as they become used to handling.

Except for very small predators it is doubtful it a *U. flagellum* under attack would survive the damage inflicted during the initial attack, even if it released its odour and successfully drove off the predator. The effectiveness of such a mechanism is reduced if the snake fails to survive. Further work with a range of suitable predators would be an interesting field of study.

ACKNOWLEDGEMENTS

The authors wish to thank those members of the Victorian Herpetological Society that assisted us in the field. We also wish to thank Brian Barnett, then President of the V.H.S., for his continued enthusiasm and support during this project.

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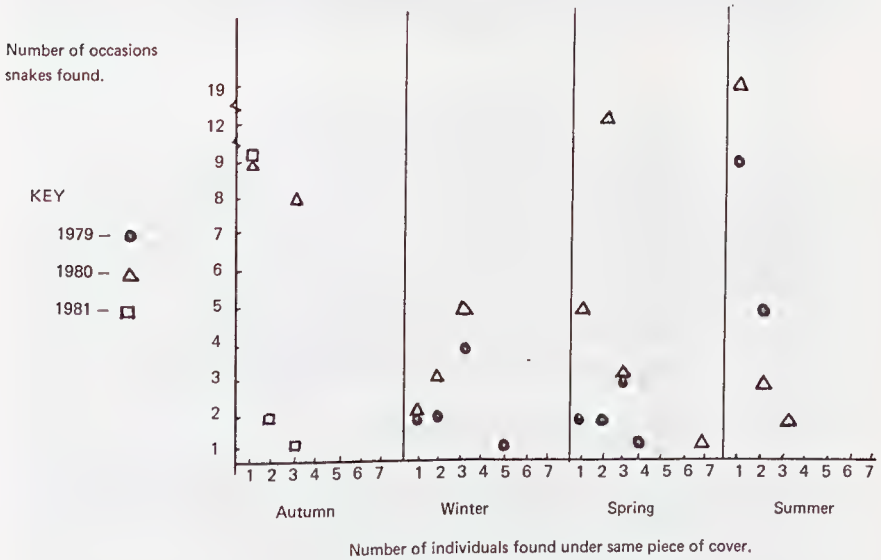
FIGURE 1.

Numbers of *Unechis flagellum* found per piece of cover.



THE FOOD OF SOME AUSTRALIAN SNAKES

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INTRODUCTION

Until recently, the food of Australian snakes was practically unknown. Shine (Shine 1977, 1980a, b, c, d, 1981a, b, 1982, 1983a, b, 1984, Shine and Charles 1982, Shine and Covacevich 1983) has now completed studies on nineteen of the 25 recognised terrestrial elapid genera (Cogger et al 1983) and has reviewed the available literature for these genera. However, only limited and rather anecdotal data exist for the Australian Colubridae and Boidae (Cogger 1983, Gow 1976, McPhee 1979, Worrell 1963).

In an earlier paper (Rose 1974) the gut contents of some snakes from Ku-ring-gai Chase National Park, north of Sydney were examined. We present here an additional 121 records representing 22 species of snakes.

METHODS

Specimens were collected as road mortalities or live specimens between September 1970 and March 1982 in Ku-ring-gai Chase National Park and elsewhere in New South Wales (see Appendix 1). The stomachs of all snakes were dissected out and the contents

examined. Where the prey was not whole and the specific identity could not be determined, the remains were usually sufficient (e.g. feathers, fur, scincid tails) to refer them to a broader taxonomic level. Snake specimens and stomach contents are housed either, permanently in the Australian Museum, or temporarily in the National Parks and Wildlife Service and Forestry Commission collections.

RESULTS AND DISCUSSION

Details of the stomach contents examined are given in Appendix 1 and summarized in Table 1. Thirty-five percent of all stomach examined were empty.

Mammals were the only recognisable food in the diamond (*Morelia spilotes spilotes*) and carpet (*M.s. variegata*) pythons (Table 1). Species identified from the stomachs of these two sub-species included the house mouse (*Mus musculus*), black rat (*Rattus rattus*), southern bush rat (*Rattus fuscipes*), long-nosed bandicoot (*Perameles nasuta*), common ringtail possum (*Pseudocheirus peregrinus*) and the rabbit (*Oryctolagus cuniculus*). Rose (1974) previously recorded an adult common ringtail and its pouched young in the stomach of a diamond python. Kavanagh (pers. comm.) observed a large diamond python capturing and ingesting a sub-adult red-legged pademelon (*Thylogale stigmatica*).

The most common prey group in the stomachs of the elapid and colubrid snakes examined in this study was skinks (Table 1). Most were unidentifiable to species level and were represented as skink remains such as tails, feet and scales. Seven skink species, one varanid and one gekkonid were identified to species level. Generally, smaller species of snakes took smaller lizard prey than larger snakes with the exception of a tree skink, *Egernia striolata* in the stomach of a curl snake (*Suta suta*).

Lizards are the most important food source in nine genera of Australian elapid snakes (Shine 1977 a, 1980 b, b, 1981 a, b). Shine found that the diets of smaller snakes were dominated by lizards while larger species, particularly the tiger snake (*Notechis scutatus*) and the black snake (*Pseudechis porphyriacus*) prefer frogs. Birds, small mammals, insects, fish and snakes are also eaten by some species.

A single bird species, the cockatiel (*Nymphicus hollandicus*), was identified from the stomach of a brown tree snake (*Boiga irregularis*). Feathers were found in the stomachs of three other species, the death adder (*Acanthophis antarcticus*), Stephens banded snake (*Hoplocephalus stephensi*) and the tiger snake (*Notechis scutatus*). Shine (1977, 1980B), examined the stomach contents of both the death adder and the tiger snake and found birds to be an important food source.

Insect remains were commonly found in the stomachs of snakes. With two exceptions this material was probably the stomach contents of the vertebrate prey eaten by snakes since much of the material was crushed beyond recognition. An elaterid (click) beetle was found in the stomach of a juvenile copperhead (*Austrelaps superbus*). Nothing else was present in the stomach suggesting that the bettle was ingested voluntarily. Shine (1977) records Orthoptera (grasshoppers) and Coleoptera (beetles) in the stomach of red-bellied black snakes. One specimen examined in this study contained a mass of grasshopper remains suggesting that they may have been used as a food source. The importance of invertebrates as a food source has been questioned by Shine (1977) and is supported by the findings of this study. However, it is evident that invertebrates are taken occasionally by some snakes.

ACKNOWLEDGEMENTS

The authors wish to thank Drs. Harold Cogger and Allen Greer (Australian Museum) for confirmation of the identity of some specimens; National Parks and Wildlife Service and Forestry Commission staff for supplying specimens.

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Appendix 1: Details of Snakes Examined from New South Wales

Species	Location	Date	Snout-Vent Length (cm)	Stomach Contents
Family Boidae				
Morelia spilotes spilotes	Ku-ring-gai Chase N.P.	7 Nov. 1970	302	Rear half *Rattus rattus.*
	Sydney			
	"	1 Mar. 1974	179	Mammal fur.
	"	Jan. 1975	—	Disgorged *Pseudecheirus peregrinus.*
	"	2 May 1975	212	Mammal fur *Trichosurus vulpecula?.*
	"	7 Dec. 1981	—	Empty.
	Sydney, Turramurra	27 Apr. 1971	244	Long-nosed Bandicoot *(Perameles nasuta).*
	Sydney, Mt. Colah	21 Jan. 1976	145	*Rattus sp.*
	Sydney, Berowra	19 Jan. 1981	120	*Rattus rattus, Mus musculus (2).*
	Gosford, Mt. White	April 1982	—	Empty.
	Nowra	1980	116	*Rattus fuscipes.*
	Gloucester	20 Apr. 1971	—	Mammal fur
	Gloucester	Apr. 1971	—	Empty.
	Eden, Ben Boyd N.P.	2 Sept. 1973	167	Empty.
	—	—	—	Small mammal claw.
M.s. variegata	Griffith	22 Oct. 1974	155	Small mammal claw and fur.
	Dorrigo	Apr. 1975	—	*Oryctolagus cuniculus.*
Family Colubridae				
Boiga irregularis	Sydney, Terry Hills	6 Feb. 1973	118	*Nymphicus hollandicus.*
	Sydney, Royal N.P.	5 Nov. 1972	—	Empty.
	Bellingen	2 Jan. 1982	—	Empty.
Dendrelaphis punctulatus	Sydney,			
	Ku-ring-gai Chase N.P.	5 Mar. 1971	115	Skinks.
	"	1 Feb. 1974	—	Skink remains.
	"	15 Jan. 1976	94	Skink remains.
	"	Dec. 1982	121	*Lampropholis delicata* (2).
	Sydney, Mt. Colah	23 Oct. 1970	132	Empty.
	Sydney, St. Ives	7 Jan. 1975	128	Frog skin.
	Sydney, Cumberland S.F.	1979	—	Empty.
Family Elapidae				
Acanthophis antarcticus	Sydney,			
	Ku-ring-gai Chase N.P.	5 Oct. 1970	65	Frog skin.
	"	11 Oct. 1971	60	Insect remains.
	"	11 Oct. 1971	—	Piece feather.
	"	2 Jan. 1973	60	Skink and mammal remains
	"	10 Oct. 1973	69	Empty.
	"	19 Jan. 1974	63	Empty.
	"	4 Jan. 1977	—	*Lampropholis mustelina.*
	"	21 Mar. 1979	34	Empty.
	"	8 Oct. 1980	65	Empty.
	Dharug N.P.	4 Mar. 1973	72	*Rattus rattus.*
Austrelaps superbus	Cooma	17 Mar. 1974	—	Empty.
	Bombala, Bondi S.F.	Dec. 1980	juvenile	Elaterid beetle.
Cacophis squamulosus	Sydney,			
	Ku-ring-gai Chase N.P.	23 Jan. 1970	48	Skink scales.
	"	24 Nov. 1975	45	*Lampropholis delicata.*
	Sydney, St. Ives	25 Feb. 1979	—	Skink remains.
	Sydney, Avalon	31 Oct. 1982	—	*Saiphos equalis.*
	Sydney, Turramurra	18 May, 1983	25	*Lampropholis delicata.*
	Sydney, Royal N.P.	—	50	Empty.
	"	—	52	Empty.
	Dorrigo	—	47	Skink scales.
	Wauchope, mt. Boss S.F.	30 Dec. 1981	Adult	Empty.
	"	30 Dec. 1981	Adult	Empty.
	"	30 Dec. 1981	Adult	Skink remains

Cryptophis nigrescens	Sydney, Ku-ring-gai Chase N.P.	2 Feb. 1973	30	Skink remains.
	"	24 Nov. 1982	43	Skink remains.
	Sydney, Cowan	2 May, 1975	41	Skink tail.
	Albury, Dora Dora S.F.	29 Oct. 1979	46	*Lampropholis guichenoti*
	Wauchope, Mt. Boss S.F.	30 Dec. 1981	Adult	Empty.
	"	30 Dec. 1981	Adult	Empty.
Demansia psammophis	Sydney, Ku-ring-gai Chase N.P.	5 Feb. 1973	49	Empty.
	"	3 Apr. 1974	55	Skink remains.
	Sydney, Wahroonga	12 Sept. 1970	59	Empty.
	Sydney, Hornsby	13 Oct. 1982	64	*Lampropholis quichenoti, Lampropholis mustelina*
	"	21 Nov. 1982	82	Skink eggs (15).
	Sydney, Muogomarra N.R.	15 Aug. 1974	78	Empty.
	Gosford, Brisbane Waters N.R.	18 Apr. 1975	62	Skink remains.
	Coonabarabran, Warrumburgle N.P.	1972	—	Skink and insect remains.
	Griffith, Cocoparra N.R.	28 Feb. 1977	109	Skink scales
Denisonia devisii	Quambone	—	173	Empty.
Drysdalia coronoides	Bombala, Bondi S.F.	1979	Adult	*Lampropholis mustelina*
Furina diadema	Sydney			
	Ku-ring-gai Chase N.P.	—	—	Empty.
	"	—	—	Empty.
Hemiaspis signata	Sydney, Wahroonga	12 May, 1971	44	Small bones (frog?).
	Dorrigo	Dec. 1974	—	Skink remains.
	Dorrigo	19 Apr. 1975	78	Empty.
	Kempsey	21 Jan. 1976	42	*Saiphos equalis*
Hoplocephalus stephensi	Dorrigo	—	84	Feather and insect remains
Notechis scutatus	Sydney, Ku-ring-gai Chase N.P.	23 Mar. 1971	101	Empty.
	"	9 Oct. 1980	138	Empty.
	Sydney, Mt. Colah	31 Dec. 1972	131	Feathers.
	Sydney, St. Ives	22 Apr. 1976	45	Skink remains.
	Sydney, Wahroonga	22 May, 1983	25	Empty.
	Gloucester	6 Feb. 1971	89	Skink remains.
	Dungog, Barrington Tops N.P.	4 Jan. 1977	132	Empty.
	Bombala	1979	Adult	Empty.
	Wauchope, Mt. Boss S.F.	1981	Adult	Empty.
Pseudechis australis	Griffith	16 Oct. 1973	196	Empty.
	Griffith, Cocoparra N.R.	23 Mar. 1976	150	Empty.
Pseudechis guttatus	Coonabarabran, Warrumbungle N.P.	1972	79	Skink scales.
		16 Nov. 1978	120	*Neobatrachus pictus.*
	Warrumbungle N.P.			Lepidoptera larvae
				Elaterid beetle.
Pseudechis porphyriacus	Sydney, Ku-ring-gai Chase N.P.	15 Oct. 1970	—	Skink remains.
	"	28 Oct. 1970	115	Unidentified mass.
	"	20 Sept. 1971	173	Leaf material.
	"	24 Oct. 1974	102	Skink remains.
	"	7 Jan. 1974	78	Skink remains.
	Sydney, Royal N.P.	8 Oct. 1970	113	Stick.
	"	26 Oct. 1970	136	Skink remains.
	Coonabarabran, Warrumbungle N.P.	1972	37	Insect remains.
	Armidale	29 Jan. 1976	—	*Litoria fallax*
	Taree	5 Nov. 1976	112	Frog remains.
	Bilpin	Nov. 1973	—	Empty.
	Comboyn	3 Nov. 1976	100	Frog remains.
	Koscuisko N.P.	Dec. 1982	—	*Typhlina nigrescens*
	—	—	—	Mass locust remains.

Pseudonaja nuchalis	Griffith	Dec. 1976	140	*Varanus gouldii, Mus musculus*
	Griffith	12 Mar. 1976	32	Skink remains.
	Hillston, Yathong N.R.	30 Mar. 1976	65	Gecko remains, Carab beetle & bug.
	Hillston, Yathong N.R.	27 Nov. 1979	122	Empty.
Pseudonaja textilis	Sydney, Ku-ring-gai Chase N.P.	17 Jan. 1975	135	Skink and Lepidoptera remains.
	"	28 Feb. 1980	juvenile	*Lampropholis mustelina*
	Sydney, Royal N.P.	Sept. 1970	208	Empty.
	Gloucester	3 Mar. 1973	65	*Mus musculus*
	"	1 Jan. 1976	67	Empty.
	"	3 Jan. 1976	66	Empty.
	"	6 Jan. 1980	150	Skink remains, fur.
	Griffith, Cocoparra N.R.	9 Oct. 1973	143	Empty.
	Mosgiel	24 Mar. 1976	–	*Mus musculus*
	Ivanhoe, Willandra N.P.	22 Nov. 1976	140	*Mus musculus* (9).
	"	18 Mar. 1976	110	Empty.
	Griffith	21 Mar. 1976	148	Fur.
	"	9 Apr. 1976	30	Skink and lepidoptera scales.
	"	16 Oct. 1973	115	Empty.
	"	16 Oct. 1973	125	Empty.
	"	22 Oct. 1974	–	Empty.
	Grenfell	14 Mar. 1975	165	*Rattus rattus*
	Grenfell, Benanbra S.F.	4 Oct. 1978		Empty.
Suta suta	Griffith	1 Mar. 1976	32	*Gehyra variegata, Egernia striolata*
	"	1976	32	Empty.
	Tibooburra	Mar. 1973	17	Skink scales.
Tropidechis carinatus	Dorrigo	11 Apr. 1975	78	*Litoria* sp.
	Wauchope, Bellangry S.F.	1981	juvenile	Empty
	Dorrigo, Dorrigo N.P.	28 Mar. 1973	82	*Lechriodus fletcheri*
Unechis gouldii	Griffith	24 Oct. 1974	32	Skink remains.
	Griffith	24 Oct. 1974	30	Skink remains.
Vermicella annulata	Sydney, Ku-ring-gai Chase N.P.	28 Feb. 1972	63	Empty.
	"	2 Feb. 1973	59	Empty.
	Sydney, Royal N.P.	1 Dec. 1981	49	Empty.
	"	13 Apr. 1983	61	Empty.
	Gosford, Mt. White	Apr. 1982	54	Empty.

Table 1. Broad taxa Used as Food by Snakes. Numbers in prey-type columns refer to references at the foot of the Table.

	No. Spec. Exam.	No. Stomachs Empty	Mammals	Birds	Reptiles								Amphibians	Invertebrates	Fish
					Reptiles	Lizards	Scincidae	Agamidae	Gekkonidae	Pygopdidae	Typhlopidae	Elapidae			
Family Boidae															
Morelia spilotes	16	4	1, 3, 8	3,7	3										
Family Colubridae															
Boiga irregularis	3	2	3	1,3,7		3									
Dendrelaphis punctulatus	7	2	3	3	3		1						18		
Family Elapidae															
Acanthophis antarcticus	10	4	1,3,8,12	1,3,12	3		1,8,12	12					1,12	1	
Austrelaps superbus	2	1					9	9			9	9	3,9	1	
Cacophis squamulosus	11	4				3	1,8,13	13		13	13		13		
Cryptophis nigrescens	6	2				3	1,8,18	18		18	18	18	18		
Demansia psammophis	10	3				3	1,11	11	11	11				1	
Denisonia devisii	1	1							16				16	16	
Drysdalia coronoides	1	0	15				1,3,15						15		
Furina diadema	2	2					3,14								
Hemiaspis signata	4	1					1,3,8,9						1,3,9	1	
Hoplocephalus stephensi	1	0	3,17	1,3		3	17	17					17	20	
Notechis scutatus	9	6	9,20	1,9,20			1,8,9						3,8,9,16		
Pseudechis australis	2	2	3		3								3		
Pseudechis guttatus	2	0	3	1	3		1						3	1	
Pseudechis porphyriacus	14	1	3,9		3		•1,8,9	9		8	1,9	9	1,3,8,9	1,9	9
Pseudonaja nuchalis	4	1	1		3		1		1					1	
Pseudonaja textilis	18	9	1,3,9	5	3		1,6	6					9	1	
Suta suta	3	1	3			3	1		1						
Tropidechis carinatus	3	1	3,19	3,19		3		19					1,3,19		
Unechis gouldii	2	0			3		1,9	9				9			
Vermicella annulata	5	0									3,10				
TOTAL	134	47													

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19. Shine and Charles (1982)
20. Vestjens (1977)

BOOK REVIEW

There are only a few small things to grumble about in Gunther Schmida's "The Cold-blooded Australians. A unique photographic study of Australia's reptiles, amphibians and freshwater fish".

The custom of splitting photographs across two pages always ruins them for me. This, I know, is a designer's decision, not the author's. Schmida's photograph of *Carlia jarnoldae* (p. 45) is a bad blue. The specimen is a good one, but is badly presented on a moss-covered rock as "one of the many small leaf litter dwelling skinks found in the rainforest of north eastern Queensland". *C. jarnoldae* is a skink of the harsh, dry country of northern Queensland. There are also some spelling mistakes (e.g. p. 91 *Quirichtys stramineus*, p. 127 *Milyeringa*, p. 133 *Edelia vittata).*

The book is a magnificent achievement, a superb product of many years hard work. I agree with the publisher's note that it is "one of the most striking and significant photographic studies of Australia's cold-blooded wildlife to have emerged in recent years". The cover is eyecatching and the book is well structured and laid out. Schmida's approach to his subject (based on drainage basins/geographical regions) brings a refreshing new approach to this sort of publication. The sectional accounts are well written and contain good information.

What more can I say? At $24.95, a full-colour work of this quality is exceptional value. "The cold-blooded Australians" is essential buying for anyone with even a passing interest in freshwater fish, frogs, or reptiles.

JEANETTE COVACEVICH,
Queensland Museum.

HERPETOLOGICAL NOTES

DEFENCE MECHANISMS IN *UNECHIS FLAGELLUM* (MCCOY)

By Grant Turner, 103 Settlement Road, Bundoora, Vic. 3083.

The small elapid snake *Unechis flagellum* employs various methods of defence when antagonised or molested. The precise mode differs individually, however these variations can be placed into three distinct categories:

1. This method of defence is employed in an attempt to frighten the aggressor while the snake escapes. Usually it involves the body and neck being expanded and the head raised several centimetres from the substrate. The snake is erratic in its movements, with the body thrashing about in a whip-like fashion (hence the species name *flagellum*). This activity may be accompanied by a low but audible hissing sound, increasing in volume with outbursts of movement. *U. flagellum* sometimes thrusts itself forward, appearing to strike, however this is merely a 'bluff'.
2. A second method, usually triggered during handling, is the emission of an unpleasant smell from the anus. This may be in a milky liquid form or as a penetrating gas. Both are equally effective and rely on the sensitivity of the predator's olfactory senses. Defaecation also occurs during such periods of stress. This method of defence is often used in conjunction with the third method.
3. Tight coiling, twisting or knotting of the body is a posture assumed when *U. flagellum* is prodded or overturned. The ribs are expanded to assist in attaining a rigid pose, and often the snake superficially resembles a shallow cone (Jenkins & Bartell, 1980). The head may be situated at the peak of the cone or beneath the coils for protection. The snake remains motionless in this position giving the impression of a non-edible or dead object. This defence acts as a decoy for minimising predation.

The ability of *U. flagellum* to utilize a number of defensive mechanisms would aid it in conflict with predators. Effectiveness would depend on such factors as the type of predator, its intelligence and capabilities as well as environmental conditions and the nature of the individual snake. These factors might be a reason why one particular defensive mode is used in preference to another.

From my observations of the species it seems that some individuals consistently utilize the same defence method while others will make use of any of the three methods on different occasions.

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A NOTE ON TURTLES NESTING IN NEW SOUTH WALES.

Harry Prosser, 29 Adams Street, Woombah, N.S.W. 2460.

On January 17, 1985 while driving up the beach at Shark Bay (just north of Iluka N.S.W. Lat 29.24S Long 153.21E) I noticed turtle tracks going up the beach so I pulled up and took some photos. I notified the National Parks & Wildlife office at Woody Head and took two officers up to see the nest. Over the next few weeks I noticed that there were holes being dug by goannas around the nest but I could not tell if they got down to the eggs.

On discussing the find with some friends, one of them told me that about eight years ago she and her husband were walking along the beach just north of Yamba N.S.W. and were amazed to see a hatchling coming up out of the sand. So it appears turtles could have been nesting in this area for years.

While fishing around the Headlands we often see turtles, and every so often we find one washed up on the beach. If they are alive we try to push them back but mostly they are too far gone. I have the shell of a loggerhead that I found on the beach.

DELMA GRAYII SMITH IN AN URBAN AREA NEAR PERTH, WESTERN AUSTRALIA.

Bradford Maryan, 20 Ockham Street, Lynwood 6155 W.A.

Delma grayii is a moderately large *Delma* which occurs in a strip on the west coast and hinterland of South-Western W.A. Within it's range it occupies a wide variety of habitats, but is mainly found in the coastal sandy areas.

This note comments upon a population of *Delma grayii* occurring at Canning Vale (Lat 31.58S, Long 115.49E) approximately 16km south-east of Perth. The area in which *Delma grayii* occurs is low open *Xanthorrhoea* (blackboy) dominated heathland with pockets of Banksia woodland. Since 1980 I have collected more than twelve specimens from a small area of this habitat. All specimens have been adults (total length 415mm - 465mm). *Xanthorrhoea* is the dominant shrub in the area and these Pygopods utilise the dead plants and the litter material for shelter. In fact these are the only shelter sites in which I have found them. There is an unlimited amount of surface debris (e.g. rubbish and logs) in the area, but to date I have been unable to find specimens underneath this material. Many reptile species utilise living and dead *Xanthorrhoea* for food and shelter, and other reptile species utilising the plant within this area are *Notechis coronatus, Rhinoplocephalus gouldii, Cryptoblepharus plagiocephalus* and *Egernia napoleonis.*

Cogger (1983) states that this species has a whitish venter. All specimens from this area have an olive green body with a bright yellow venter.

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ISLAND HERPETOFAUNAS IN NEW SOUTH WALES: A REVIEW

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INTRODUCTION

Island herpetofaunas have been the subject of much interest in most Australian states, in line with general interest in island biogeography. However, with the exception of a single paper on Lion Id, in Broken Bay (Mackay, 1959), no detailed studies have yet been undertaken on the herpetofauna of New South Wales coastal islands. Indeed, even basic herpetofaunal species lists have not yet been drawn up. In attempt to provide some basis for further observations and to stimulate further work, I offer the following summary of specimen and literature records for NSW island herpetofaunas.

Scalation characters follow Shea and Peterson (1985), and nomenclature follows Cogger (1983) and Shea and Peterson (1985).

ANNOTATED LIST OF ISLAND HERPETOFAUNAS (From north to south)

South Solitary Id: *Lialis burtonis* has been recorded from this island (Kluge, 1974; Lane, 1975c). These records are supported by a specimen, Australian Museum R11086 (pre: T.J. Aird). Although no other species has yet been recorded from South Solitary Id, the presence of a saurophagous lizard suggests that other reptiles also occur.

Muttonbird Id: Swanson (1976) records *Lialis burtonis* as present, and reports the existence of a colony of *Physignathus lesueurii* prior to 1930. Neither record is supported by voucher specimens. The presence of *Lialis burtonis* suggests that other lizard species are present.

Broughton Id: Four species have been definitely recorded from this island. Hull and Grant collected *Ctenotus robustus* (AM R5970). *Ramphotyphlops nigrescens* (AM RS975-76). *Hemiaspis signata* (AM R5522) and *Limnodynastes peronii* (AM R5523, R5974). I have been unable to confirm the identity of AM R5522 as it was exchanged with Auckland University in 1935. Lane (1976b) records *Sphenomorphus* sp., possibly in reference to *Ctenotus robustus*, as very common. Local fishermen reported the presence of large brown snakes (probably *Pseudonaja textilis*) following extensive flooding on the adjacent mainland in the late 1950's (Lane, 1976b), although Lane did not see any in five visits to the island.

Boondelbah Id: Hull (1911) noted small lizards basking on the sand heaps at the entrance to *Puffinus sphenurus* burrows, that sheltered in the burrows when disturbed. There are no specimen records from the island to indicate the species involved.

Cabbage Tree Id: The subtropical rainforest on this island is unique on coastal islands in NSW, and supports *Cacophis squamulosus* (Australian National Wildlife Collection R132; Fullagar, 1976) and *Saiphos equalis* (AM R17962, adult female and two neonates, born 16.ii.1959; pre: A.D'Ombrain). Hindwood and Serventy (1941) had earlier suggested that snakes were not known from the island. Hull (1911) saw a small lizard on Cabbage Tree Id. As this was presumably seen active, it suggests the occurrence of a second lizard species on the island.

Pulbah Id, Lake Macquarie (33°06'S 151°36'E): H.G. Cogger has collected *Saiphos equalis* (AM R54589-90) and *Lampropholis delicata* (AM R54602-11) on this island. AM R54589 is gravid, with 2L/1R greatly enlarged yolking ovarian follicles.

The *L. delicata* material has SVL 27-42mm; midbody scales 24-26, $\bar{x}$ 25.3, mode 26, n 9; paravertebral scales 51-55, $\bar{x}$ 52.3, n 9; subdigital lamellae 22-28, $\bar{x}$ 25.4, n 16;

supraciliaries usually 8 (rarely 7 or 9 unilaterally). All six adult females (SVL 35.5 - 42mm) are gravid, with 1-4 ($\bar{x}$ 2.8) greatly enlarged yolking ovarian follicles or oviducal eggs.

Wells and Wellington (1985) list a publication by Wells (1983) dealing with "a reptile-collecting trip to Pulbah Id", but I have been unable to trace a copy of the latter paper.

BROKEN BAY ISLANDS

a. Lion Id (33°34'S 151°19'E): Mackay (1959) records five species from this island: *Sphenomorphus quoyii, Saiphos equalis, Physignathus lesueurii, Varanus varius,* and "the copper tailed skink, *Sphenomorphus australis".* The latter is probably *Ctenotus robustus*, as this species has been collected on the island (AM R65492). Voucher specimens are also available for *S. quoyii* (AM R15274, R19405, R74092) and *P. lesueurii* (AM R19406, R74849-51, R74853). McGill (1954) had earlier seen a few *Physignathus* and numerous small skinks, but no goannas. Mackay (1959) noted seaweed and crab remains in fresh *P. lesueurii* faeces, and suggested that the population was declining, with most individuals emaciated. Lane (1962) notes berry seeds in *Physignathus* faeces, and records *Physignathus, V. varius,* and three (unidentified) skink species (see also Lane, 1975b).

b. Scotland Id (33°39'S 151°17'E): Three separate records of *Cacophis squamulosus* are known from this island: AM R14666, pre: Irvine, R41640, ii. 1974, Moodie and R104133, 7.i.1982, J. Lowry. No lizards have yet been recorded, although the presence of a saurophagous snakes suggests that they occur.

c. Dangar Id (33°32'S 151°14'E): Recher (1976) records lizards in the diet of pied currawongs on Dangar Id, although there are no specimen records to indicate the species. *Cacophis squamulosus* (AM R15079, pre: N. French) has also been recorded, although I was unable to find this specimen in a search of the Australian Museum collection.

d. Long Id (33°33'S 151°13'E): A single specimen of *Ctenotus taeniolatus* (R92291, 7.ix.1979, H.F. Recher) from this island is lodged in the Australian Museum.

Wells and Wellington (1985) list a publication by Wells (1984) dealing with "herpetofaúna observed on Long Id" but I have been unable to trace a copy of the latter paper.

e. Milson Id (33°31'S 151°11'E): *Carlia burnetti* (AM R6076) and *Anomalopus swansoni* (AM R4820, R6078; Greer and Cogger, 1985) are recorded, based on specimens donated by the "Department of Microbiology". Copland (1949) attempted to recognise a southern race, *sydneyensis,* of *Carlia burnetti.* The Milson Id specimen, though within the distribution of *C. b. sydneyensis*, is intermediate between the two races in scalation, agreeing with the nominate subspecies in degree of separation of prefrontals and contact of anterior loreal with first suprelabial, and in having an acute lobule on the anterior margin of the ear, but agreeing with *C. b. sydneyensis* in degree of separation of nasal scales, size of postmental, and size of ear aperture.

THE FIVE ISLANDS GROUP

Davis **et al.** (1938) provided an extensive introduction to what was planned to be a series of papers of the ecology of the Five Islands group. The subsequent papers were unfortunately never published, and Davis' specimens were donated to S.J. Copland's herpetological collection, which was subsequently presented to the Australian Museum, along with Copland's register, which contains much data on habitat and gut contents for the Five Islands material. Davis **et al.** (1938) note "at least four species of lizards" for the group.

a. Flinders Islet (No. IV of Davis **et al.**): Davis **et al.** record lizards from this islet, while Battam (1976b) records *Sphenomorphus* sp., although there are no voucher specimens of any *Sphenomorphus* in collections. The Copland collection contains ten *Lampropholis delicata* from Flinders Islet, now AM R61055, R61255, R61645 (not found), R64406, 20.iii.1938, Davis; R60931, R64356, 22-23.iii.1938, Davis and Copland; R61064, Davis 16.vii.1938; R61268, 18.ii.1939, Davis; R60892 and R61617 (not found), 27.1.1940, Copeland. R61064, R61255, R61268, R61645 and R64406 were found "under stones near cave", R60892 and R61617 "under stones on top of island among pigface" and R60931 and R64356 "on plateau".

Gut contents for these specimens are as follows: R61055, "acarinid 5.3mm long, *Ixodes?*; 5 small winged ants"; R61064, "remains of 4 small black winged male ants"; R60931, "young lepidopteran larva (perhaps 2nd instar of *Cactoblastis*); nymph of lygaeid (Hemiptera), both quite undigested"; R64356, "isopods 10, each 3mm, 2 smaller; 2 forelegs, one 2nd leg of *Gryllotalpa*; chelicerae of large spider (each 3-4mm); tergites and forewing of small lygaeid"; R64406, "1st instar lygaeid; spider 7mm, young ditto"; R61645, "small lepidopteran larva, unidentified chitin"; R61255, "much digested remains of spider as in [R64406]".

The adult material from this island has SVL 44.5 - 47.5mm, midbody scales 28 - 30, $\bar{x}$ 28.6, mode 28, n 7; paravertebral scales 51-56, $\bar{x}$ 54.1, n 7; subdigital lamellae 22-25, $\bar{x}$ 23.8, n 15, and supraciliaries usually 8 (7 unilaterally in two cases). The dorsal coloration consists of six dark longitudinal stripes from nape to base of tail. Similarly coloured individuals have been collected from the Robertson-Kangaroo Valley region on the adjacent mainland.

b. Martin Islet (No. III of Davis **et al.**). Battam (1976d) records *Sphenomorphus* sp. from Martin Islet, although there are no voucher specimens. The Copland register lists three specimens of *Saiphos equalis* and two *Lampropholis delicata*. I have examined one of the *Saiphos* (AM R60607, 16.vii.1938, under stone, Copland) but I have been unable to find the other two specimens (Copland 1221-1222, 6.vi.1941, south-west corner, under large basalt boulders, nearly in pigface and grass; soil coarse and sandy, fairly damp).

Both of the *Lampropholis* (AM R60940, 23.iv.1938, *Sporobolus* community, Davis; R64366, 6.vi.1941, south-west corner, Copland) have been examined. Both are of the same striped-back form as the Flinders Islet material, and have SVL 32.5 - 33.5mm, midbody scales 27-29, paravertebral scales 53-54, subdigital lamellae 25-26, supraciliaries 8-9. Gut contents for R60940 are "2 small black ants; moth larva 1cm; 2 adult *Aedes;* chalcidoid (Hymenoptera) 4mm; moth 6mm, fairly complete; head of same species; 2 small 5mm muscoid flies and head of third; legs of small spiders; ptiliid beetle 1mm; "corcopid" 3mm; adult mycetophil (Diptera) 1.5mm; young muscoid larva 2mm".

c. Bass Islet (No. V of Davis **et al.**): The Copland field register records 23 *Lampropholis* specimens from this islet. All but two of these (Copland 699, 701) have been located and examined, and all are *L. delicata.* The specimens are now registered as AM R61047, R69000, R61051, 16.vii.1938, under stones, Copland; R60932, R61131, R61034, R61044, R61149-50, R61077, R61128, R64066-67, R64241-43, R64403-05, R64355, R64452, 28.i.1940, under stones where earth was fairly damp, numerous among stones hidden in dense masses of *Mesembryanthemum* which covers the soil, rock and loose stones over a great part of the island, Copland.

Adult material from this island has SVL 40-35mm, midbody scales 26-28, $\bar{x}$ 27.2, mode 28, n 17; paravertebral scales 50-57, $\bar{x}$ 53.4, n 17, subdigital lamellae 21-26, $\bar{x}$ 23.4, n 32, and supraciliaries usually 8 (rarely 5, 6, 7 or 9 unilaterally). The dorsal pattern is much less strongly striped than Flinders and Martin Islet material, usually without stripes, rarely with dark flecks arranged in lines. There are no significant differences between Flinders and Bass Islet material in number of paravertebral scales and subdigital lamellae (t-tests, $p > 0.05$). Bass Islet material has significantly fewer midbody scales than Flinders Islet material (Mann-Whitney U test, $U = 18$, $p < 0.01$), although the modal value for both populations is 28. The differences between the two populations do not seem consistent enough for more than one species to be recognised at the present time.

d. Big Island (Nos. I and II of Davis **et al.**): Rodway (1928) records "a few smooth lizards, about 6" (15 cm) long" on Big Id. These were presumably *Sphenomorphus quoyii*. Davis **et al.** (1938) record *S. quoyii* from the zone behind the beach, where they feed on flies. Gibson (1976) records *Sphenomorphus sp.*

I have examined 29 specimens of *S. quoyii* from this island: R59500, R66849, 11.xii.1938, sunning among grass in sandy soil, Copland; R74085-91, 28.i.1940, in burrows of seabirds, sandy soil or rocky near sea, Copland; R74095, 6.vi.1941, under stone in grass near small spring, Copland; R74096-106, 15-16.xii.1939, near camp hummocks, Davis; R74107-110, 1939, Davis; R110634-36, 19.xi.1983. Two specimens listed in the Copland register (379, 11.xii.1938; 1235, 15-16.xii.1939) could not be found. This material has SVL 39.5-115mm; midbody scales 35-42, $\bar{x}$ 38.8, mode 38, 40,

n 23; paravertebral scales 68-79, x 74.0, n 23; subdigital lamellae 27-32, x 29.6, n 45.

There are three gravid females. AM R74099 (SVL 105mm) has 1L/3R unshelled oviducal eggs. AM R110634 (SVL 112mm) has 3L/2R unshelled oviducal eggs, and R66849 (SVL 100mm) has 3 fully developed young. All other material, both male and female, is non-reproductive.

The Copland collection also contains a single *Sphenomorphus heatwolei* (AM R74083, 11.xii.1938). This species is at the northern limit of its coastal range on the adjacent mainland (G. Swan, *pers. comm.*).

A single *Lampropholis delicata* (AM R64415, Davis, 1939) has been recorded for the island. This specimen is a non-gravid female, SVL 42.5mm, midbody scales 28, paravertebral scales 54, subdigital lamellae 24-26, but has only 7 supraciliaries, rare in *L. delicata*, but characteristic of *L. guichenoti* (Clarke, 1965), and has a white midlateral stripe bordered above and below by black. Similarly patterned *L. delicata* occur sporadically in NSW from the New England tableland to at least Wombeyan Caves.

An agamid is also listed from Big Island in the Copland register (1249, Davis, 1939). This specimen was registered as *Amphibolurus muricatus* (AM R74779) but I have been unable to find the specimen to verify the record.

Windang Id (34°33'S 150°53'E): A single subadult *Sphenomorphus quoyii* (AM R74125) was collected by Copland on 25.ix.1946. Windang Id is a tombola separated from the mainland by a long unvegetated sand spit, covered at high tide.

Bowen Id: Lane (1976f) records *Egernia* sp. as very common, and notes local reports of snakes on the island. The *Egernia* record is most likely to refer to *Sphenomorphus quoyii*. J. Wombey (*pers. comm.*) observed water skinks on Bowen Id in 1976, and *S. quoyii* has been recorded foraging in the supralittoral zone at Caves Beach, on the adjacent mainland (AM R59861). There are apparently no voucher specimens for the island.

Brush Id: *Ranidella signifera* (AM R12280, newly metamorphosed frog and tadpole) and a juvenile *Leiolopisma platynotum* (AM R12279) were collected by Davis on 5.ix.1937.

Belowla Id: Lane (1973b) recorded *"Ergernia* sp." as numerous during a two hour visit on 17.xii.1972, although he subsequently suggested that these were *Sphenomorphus quoyii*, following a later afternoon and night visit on 16.xii.1976 (Lane, 1977).

The Tollgates: McKean and Fullagar (1976) report *Sphenomorphus tympanum* as common on both islets. This record is probably based on *S. heatwolei*, at that time undescribed and included within *S. tympanum*. Two specimens of *S. heatwolei* (AM R5428-29) were collected from the Tollgates by H.S. Grant.

Montagu Id: Six *Lampropholis* specimens were collected by Davis, Grant and Wright from Montagu Id. Four of these are definitely *L. guichenoti* (AM R10024a-b, R61099, R64357; Clarke, 1965). One is *L. delicata* (AM R12278), and the other (AM R12277) is too darkened and dessicated to assign with any confidence, although most probably *L. guichenoti*. A further *L. guichenoti* (ANWC R1128, 4.iv.1974) has been collected since.

There are three specimens of *Egernia whitii* recorded from the island: ANWC R1126-27, 3.iv.1974 and R3185, 30.iii.1981. This is presumably the *Egernia* sp. recorded by Fullagar (1973).

DISCUSSION

Although the data currently available are very limited, several features are apparent.

Frogs have only been reported from Broughton and Brush Islands. These are the only two NSW coastal islands reported to have moist swampy areas suitable for frogs (Table 1), and are likely to be the only frog-inhabited islands.

With the exception of *C. squamulosus* on Cabbage Tree Id, all species recorded from islands off the NSW coastline (as opposed to harbour and estuary islands) are common inhabitants of coastal dune systems and rocky headlands on the adjacent mainland.

There is a strong correlation amongst islands off the NSW coast between island size and the presence of reptiles (data from Table 2; Mann-Whitney U test, z = 3.12,

$p < 0.002$), with no reptiles known from islands of less than 2.3 ha. Correlations between species richness and island size have been reported for Western Australian Islands (Kitchener and How, 1982).

Overall, there is no correlation between distance of island from mainland and the presence of reptiles (data from Table 2; Mann-Whitney U test, $z = 0.74$, $p > 0.05$). For islands north of Sydney, there is a relationship between island height and the presence of reptiles (Table 2; Mann-Whitney U test, $U = 8.5$, $p < 0.05$), although this is not the case for islands south of Sydney. Given the changes in sea level during the Quaternary, these relationships suggest that island herpetofaunas north of Sydney are relicts of lower sea levels rather than due to drift from the mainland. This may not be true for islands south of Sydney, or for harbour, estuary or lake islands.

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TABLE 1
Habitat data for NSW coastal islands (north to south)

	Habit	Reference
Cook Id	Well covered with grasses, tussocks and creepers; clamps of *Cupaniopsis* to 3m	Lane (1973c)
Juan & Julia Rocks	Mostly bare rock; scanty vegetation in small crevices	Lane (1976a)
North Solitary Id	Mostly bare rock; patches of low herbs and grasses	Lane (1974a)
North Rock	Pigface, pigweed and low herbs	Morris (1975b)
North-west Solitary Id	Mostly bare rock with scattered succulents; 30% cover of low grasses and herbs	Morris (1975a)
South-west Solitary Id	Thick vegetation of grasses, shrubs and vines on crown	Lane (1975a)
South Solitary Id	Grasses and low herbs	Lane (1975c)
Split Solitary Id	Grasses and low herbs on plateau	Lane (1974b)
Muttonbird Id	Thick low vegetation of herbs and grasses; low stands of *Cupaniopsis* and *Lantana*	Swanson (1976)
Little Muttonbird Id	Mostly bare rock; couch and low herbs with a dense low thicket of *Cupaniopsis* to 1.8m on higher parts	Roberts (1976)
Korffs Islet	Mostly rocky; scattered patches of low herbs	Lane (1976j)
Sawtell Islet	Mostly rocky; higher parts with grasses and low herbs	Holmes (1976b)
Green Islet	Low heath on plateau	Holmes (1976a)
Delicate Nobby	Good cover of grass, tussocks and *Carpobrotus*	Lane (1976i)
Broughton Id	Much of island covered with grass and bracken; few scattered trees; swampy area in centre	Lane (1976b)

Little Broughton Id	Most of island covered with dense matrush and vines; grassed area at NW end; low trees forming a crown at peak	Lane (1976c)
North Rock, Broughton	Most of island covered with matrush	Lane (1976d)
Inner Rock, Broughton	Most of island covered with matrush; low *Acacia sophorae* at peak; low herbs around margin	Lane (1976e)
Boondelbah Id	Sedge tussocks; banks of *Westringia rosmarinifolia* in rocky areas; grass lawns in flat portions	Morris (1976)
Cabbage Tree Id	Western slopes with subtropical rainforest and scrub; matrush tussock grassland; eastern slopes more sparsely vegetated	Fullagar (1976)
Little Id	Mostly bare rock; *Sesuvium* in small soil patches	Lane (1976k)
Shark Id	Mostly rocky; tussock grasses, creepers, small bushes, stunted *Lantana*	Lane (1976l)
Moon Id	Mostly rocky; plateau with coarse grasses, *Carpobrotus* and *Opuntia*	Gray & Gwynn (1974)
Bird Id	Mostly covered with grasses, tussocks and *Carpobrotus;* few stunted trees to 2m; island bombed during World War II	Lane (1973a)
Big Id	Good cover of grasses and matrush; low *Correa* and *Westringia*	Gibson (1976)
Martin Islet	Vegetated with couch, *Carpobrotus* and *Opuntia* only on NW corner	Battam (1976d)
Flinders Islet	Small herbs and succulents; *Myoporum, Westringia & Atriplex* on northern end	Battam (1976b)
Bass Islet	Grasses and succulents on NW side	Battam (1976c)
Stack Islet	Well covered with grass and low shrubs	Battam (1976a)
Bowen Id	Coastal *Banksia-Acacia-Casuarina* heath; matrush and grasses	Lane (1976f)
Brush Id	*Banksia-Casuarina* scrub in depressions and along ridge; grassy knolls; *Phragmites* swamps; *Carpobrotus* and matrush	Morris (1974)
Belowla Id	Grasses, tussocks, *Carpobrotus* and low herbs	Lane (1973b)
Grasshopper Id	Grasses; matrush, *Carpobrotus* and low bushes	Lane (1976g)
The Tollgates	Heaths of *Rhagodia, Tetragonia, Carpobrotus, Acacia, Casuarina, Leucopogon,* and *Westringia,* mostly overgrown with *Ipomoea;* plateau covered with matrush	McKean & Fullagar (1976)
Wasp Id	Grasses and low herbs	Lane (1976h)
Montagu Id	Matrush with creepers and grasses; bracken; *Phragmites* and *Juncus* in wetter areas; tussocks and open grassy areas.	Fullagar (1973)

TABLE 2

Position, size and distance from mainland of NSW coastal islands

(Sources of data as for Table 1)

	Position	Area	Height	Distance
Cook Id	28°12'S 153°35'E	4.7ha	30m	1km
Juan & Julia Rocks	28°37'S 153°36'E	1.8ha	17m	3km

North Solitary Id	29°55'S	153°23'E	35ha	55m	12km
North Rock	29°59'S	153°15'E	4.0ha	15m	3km
North-West Solitary Id	30°02'S	153°16'E	1.9ha	20m	7km
South-West Solitary Id	30°09'S	153°14'E	6.8ha	?	2km
South Solitary Id	30°12'S	153°16'E	13.8ha	43m	16km
Split Solitary Id	30°14'S	153°11'E	3ha	40m	2.4km
Muttonbird Id	30°18'S	153°09'E	8ha	45m	joined
Little Muttonbird Id	30°18'S	153°08'E	2ha	5m	0.2km
Korffs Islet	30°19'S	153°09'E	1ha	16.4m	0.6km
Sawtell Islet	30°23'S	153°06'E	3.0ha	5m	0.08km
Green Islet	30°55'S	153°05'E	2.3ha	40m	0.05km
Delicate Nobby	31°16'S	152°58'E	2.5ha	30m	joined
Broughton Id	32°37'S	152°19'E	138ha	91m	2.3km
Little Broughton Id	32°37'S	152°20'E	36ha	98m	2.3km
North Rock, Broughton Id	32°36'S	152°19'E	8.8ha	23m	3.4km
Inner Rock, Broughton Id	32°36'S	152°18'E	1.1ha	10m	1.6km
Boondelbah Id	32°42'S	152°14'E	9.3ha	55m	4km
Cabbage Tree Id	32°42'S	152°14'E	30ha	120m	1.4km
Little Id	32°42'S	152°15'E	1.3ha	12m	3km
Shark Id	32°45'S	152°12'E	1.8ha	25m	0.05km
Moon Id	33°05'S	151°41'E	2.3ha	6m	0.6km
Bird Id	33°14'S	151°36'E	12ha	50m	1.6km
Big Id	34°29'S	150°56'E	19ha	20m	0.5km
Martin Islet	34°29'S	150°56'E	2.5ha	16m	1km
Flinders Islet	34°27'S	150°56'E	2.8ha	13m	1.5km
Bass Islet	34°28'S	150°57'E	2.3ha	16m	3km
Stack Islet	34°38'S	150°52'E	1ha	30m	joined
Bowen Id	35°07'S	150°46'E	50ha	40m	?
Brush Id	35°32'S	150°25'E	35ha	43m	0.3km
Belowla Id	35°33'S	150°24'E	4ha	8m	0.6km
Grasshopper Id	35°38'S	150°20'E	4.8ha	25m	0.15km
The Tollgates	35°45'S	150°16'E	12.9/10.4ha	50m	?
Wasp Id	35°40'S	150°19'E	8ha	15m	0.3km
Montagu Id	36°15'S	150°14'E	49ha	64m	10km

HERPETOLOGICAL RECORDS FROM NORTHERN N.S.W.

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A number of reptiles and several amphibians were observed during a two week period in November-December 1984 near Boggabilla, N.S.W. (28°37'S, 150°22'E) on the McIntyre River which forms the border with Queensland. The habitat is principally tree savannah (Moore, 1970) on cracking clay soil ('blacksoil'), but has been extensively cleared, especially to the south and west, for cattle and cotton. In spite of recent moderate rain the ground remained deeply cracked in many places. The species recorded were:
GEKKONIDAE: *Gehyra variegata* under bark of standing or fallen dead trees, especially on river bank.

Heteronotia binoei under logs or other loose ground cover. Both species fairly common, and both utilized ground cracks when disturbed.
AGAMIDAE: *Pogona barbatus*, 1', perched on a fence post in the morning at Billawindi Caravan Village ('camping area' below), just west of Boggabilla.

Physignathus lesueurii — several were observed active on the river bank. The map in Cogger (1983, p.249) suggests that this species is known from the Macquarie River; this record indicates that it also occurs on the McIntyre, so may extend even further inland.
VARANIDAE: *Varanus gouldii* — a large, pale yellowish DOR goanna seen south-west of Boggabilla was thought to be this species but was not examined closely.

Varanus varius — a large typically marked Lace Monitor was active on the road near Boobora Lagoon, south-west of Boggabilla, at about 2.30 p.m.

Varanus tristis — one specimen was active in a tree at the camping area. It was a male, SVL 250mm, total length 710mm. It did not conform to either of the colour races *tristis* or *orientalis* (e.g. Houston, 1978) or any of the variants described by Christian (1981) so is worth describing here. Head yellowish, with a distinct pale-edged dark stripe through the eye. Body grey, with pale-centred black ocelli forming longitudinal and transverse rows. This pattern overlain by about 5 or 6 diffuse-edged but quite bright red crossbands. Tail completely black above; ventral surface of body and anterior part of tail yellowish grey, with ocellate pattern breaking up into scattered dark flecks.
SCINCIDAE: *Cryptoblepharus virgatus* seen active on trees near the river and Boobora Lagoon (a permanent deep lake) — not *C. plagiocephalus* which occurs in similar conditions in the Macquarie Marshes, and was the only *Cryptoblepharus* recorded there by Australian Herpetological Society field trips (AHS 1977, pers. obs. 1980).

Morethia boulengeri several seen active or under logs.

Tiliqua scincoides 2 adults under logs.
ELAPIDAE: *Denisonia devisii* subadult female (SVL 230mm, tail 37mm) under a log in paddock between camping area and river.

Pseudechis guttatus 1 adult seen active in the late afternoon, escaped to rabbit burrow (1.5m approx., grey-brown colour), and two large sloughs in the same paddock. Also 1 DOR (SVL 485mm, tail 92mm) between there and the town; head black, merging gradually with dorsal colour of dark, slightly brownish grey above, paler blue-grey laterally and ventrally, black spots on the tips of many mid-dorsal and all lower lateral scales, but each ventral with a dark base, fusing into continuous dark-ventral zone posteriorly (this is a darker version of the juvenile pattern described by Charles **et al.**, 1979).

Pseudechis porphyriacus 1 active in the camping area (SVL 710mm, tail 137mm, male) at 5.30 pm (Queensland time). One slightly larger specimen was seen swimming across the river.

Pseudonaja sp., probably *textilis,* recorded from a partial slough identified by body scalation.

Parasuta dwyeri 1 under log in long grass in the same paddock described above (male SVL 230mm, tail 32mm).
MYOBATRACHIDAE: *Limnodynastes salmini* 1 near the Goondiwindi bridge in a short burrow under sheet iron.

Notaden bennetti 1 active after rain at night, in the camping area.
PELODRYADIDAE: *Litoria caerulea* several subadults aggregated under bark of fallen tree near the river.

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SUBCAUDAL SCALATION ANALYSIS OF *PSEUDONAJA TEXTILIS* (DUMERIL AND BIBRON) IN THE EASTERN RIVERINA REGION

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ABSTRACT:

Examination of sixty nine specimens of *Pseudonaja textilis* from the eastern Riverina region showed 13 (19%) with all subcaudal scales divided and 56 (81%) with one or more undivided subcaudals. The number of undivided anterior subcaudals ranged from 1 to 26. No significant correlations between presence of undivided subcaudals and other scalation or color variations was found. There is no suggestion that these findings represent anything other than intraspecific variations.

INTRODUCTION:

Pseudonaja textilis is a widely distributed species in eastern Australia from 'Cape York Peninsula to south-eastern SA' (Cogger 1983). The species is found in a wide range of habitats and might be expected to show regional variations in detailed morphology. Hune (1947), Kinghorn (1956), Gow (1976), Jenkins and Bartell (1980), Mirtschin and Davis (1982) all indicate that the subcaudal scales in this species are all divided. Cogger (1983) uses all divided subcaudals as an identifying character in a generic classification key but concedes as does Waite (1929), that rarely or occasionally undivided anterior subcaudals are found in this species. Cogger (*op. cit.*) also states that existing *Pseudonaja* species are 'poorly defined' and that 'most species are probably composite'.

P. textilis is undoubtedly the most abundant species of snake in the eastern Riverina region and although full grown adult specimens are encountered infrequently the juveniles (usually less than about one year old) are quite commonly seen in the wild, in back gardens, as road kills or brought in by the family cat.

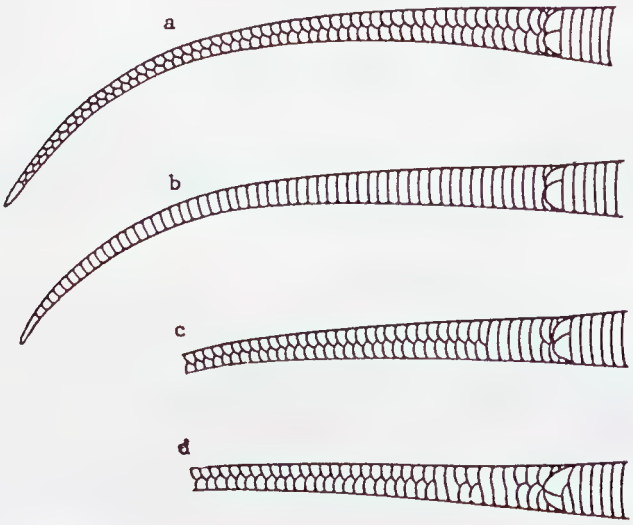

Fig. 1 Subcaudal scalation patterns seen in elapid snakes.

The state of the subcaudal scalation is commonly used as an important taxonomic character in defining certain elapid genera, (Waite 1929, Hunt 1947, Kinghorn 1956, Mirtschin and Davis 1982, Cogger 1983, Sutherland 1983).

The three states usually referred to are as follows:

1. All subcaudals divided (fig. 1a)
2. All subcaudals undivided (fig. 1b)
3. Some anterior subcaudals undivided (fig. 1c).

Fig. 1d shows another condition commonly occurring in *P. textilis* from the eastern Riverina where the anterior subcaudals show a variable pattern of mixed divided and undivided scales, (the half-width terminal ventral scale is also not uncommon).

RESULTS AND ANALYSES

The 69 specimens examined included 14 adults and subadults also 55 juveniles.

Colouration: All juveniles (n = 54, one specimen was minus its head) possessed normal brown/black head markings and a dark nuchal band (see Cogger 1983). Dorsal and lateral surfaces were strongly banded with dark brown to black in 6 juveniles (11%). Faint banding was seen in 4 juveniles (7%), (a condition also found in some adults in the eastern Riverina). The ground colour of the dorsum varied from greyish through grey/brown to light tan. Other colour variations included differences in the width, number and arrangement of the cross bands also the occasional presence of a yellow or orange occipital band in some juveniles.

Measurements and meristics: Range of total body length 205 — 1,565 mm; mid-body scale rows 17; ventral scales 192 — 216 ($\bar{x}$ = 206, s.d. = 4.8, n = 64); subcaudal scales 47 — 70 ($\bar{x}$ = 65, s.d. = 3.3, n = 65); tail length range 17.7 — 22.1% of snout-vent length ($\bar{x}$ = 19.7, s.d. = 1.1, n = 60) with no evidence of a bimodal distribution, (insufficient specimens were sexed to determine if there was a significant sex difference in tail lengths). Two juveniles (4%) possessed undivided anal scales. The distribution of the undivided subcaudal scales (fig. 2) shows that 56 (81%) had one or more, and 43 (62%) had three or more.

No significant correlations were found between the number of undivided subcaudals and 1) total number of subcaudals, 2) number of ventral scales, 3) tail length, 4) colour variations. There was also no significant correlation between the numbers of ventral and subcaudal scales (sexual dimorphism may have obscured any correlation here). A significant correlation was found between the number of subcaudals and tail length ($p = 0.01$).

DISCUSSION:

The fact that 55 (80%) of the specimens were juveniles with typical coloration indicates that it is unlikely that a second species is involved. This is further confirmed by the low correlation coefficients r_1, r_2, r_3, r_4, and also the fact that there was no significant difference between measurements and scale counts for adult and juvenile specimens (Fig. 2).

If these regional results are representative for the species distribution then one could expect that about 80% of eastern brown snakes would be misdiagnosed on scalation characters (probably as *Pseudechis australis* or king brown snakes, using Cogger 1983). *P. textilis* and *P. australis* have similar general morphologies and both have considerable color variations thus increasing the risk of misidentification especially of adult and subadult specimens which lack the typical juvenile coloration patterns.

The implications for hospital treatment of 'brown snake' envenomation cases are significant because of the differing toxins and symptomatologies produced by *Pseudonaja* and *Pseudechis* species (Sutherland 1983). The advent of snake venom detection kits involving enzyme linked immunosorbent assays (ELISAS) has however considerably reduced the potential risks of snake misidentification, which may occur particularly in large areas of eastern Australia where the distribution of *P. textilis,* and *P. australis* overlap.

From the point of view of species recognition and distributions caution should be observed when considering subcaudal scalation as a taxonomic character.

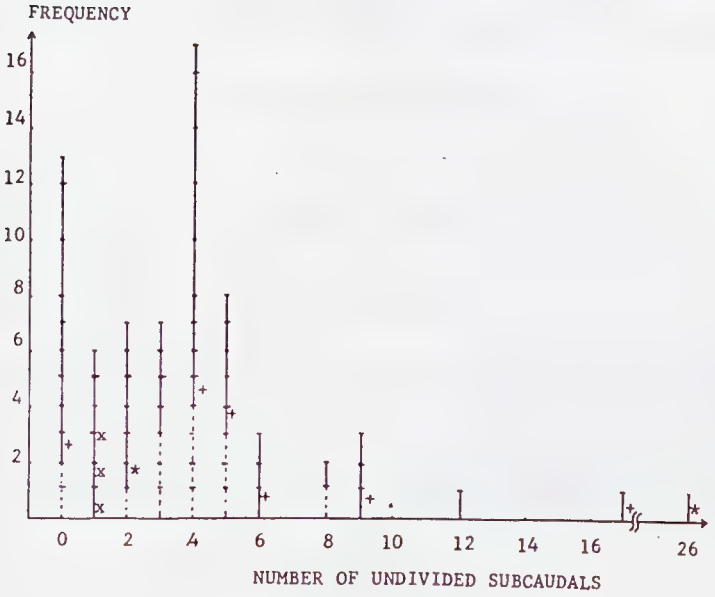

Fig. 2 Frequency distribution of undivided subcaudal scales in *P. textilis* n = 69.+ indicates black banded (juvenile) colormorph, x indicates faintly banded specimens, * indicates specimens with undivided anal scales. Dashed lines indicate adult specimens.

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ON A COMMON NAME FOR THE SNAKE, *PSEUDECHIS BUTLERI* WITH A DESCRIPTION OF A COLOUR VARIANT FROM THE EASTERN GOLDFIELDS

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Although *Pseudechis butleri* was only described in 1982 various vernacular names have already been ascribed to it, i.e. Butler's Snake (Gow, pers. comm.) Butler's Black Snake (Chapman, 1985), Yellow-bellied Black Snake (Storr, 1983) and Spotted Mulga Snake (Bush, 1985). The first 2 names are derived from the scientific name, the 3rd refers to diagnostic colouration, and the 4th to the dorsal pattern which distinguishes it from the common Mulga Snake (*P. australis*). I believe a common name should be primarily descriptive and secondarily convey a relationship to closely allied forms. Therefore, omitting the first 2 names because they are not or only partly descriptive and thus convey little to the uninformed layman, we move onto the last 2 mentioned. 'Yellow-bellied Black Snake' is an ideal common name, but it is already widely used on the coast, to the south of *P. butleri's* geographic range, for the Tiger Snake (*Notechis scutatus*). If it is also used in literature (especially anecdotal) for *P. butleri* then it can only cause confusion to those residing on the coast where the western colour-phase of the Tiger Snake is found. I first heard a common name used to describe *P. butleri* in 1983. While visiting Laverton and conversing with the local constabulary they referred to a 'spotted mulga snake' they had recently killed near town. Though I was unable to examine the snake they had despatched their description was of *P. butleri.* This name is most suitable as many residents of and visitors to the Goldfields are familiar with the Mulga Snake (*P. australis*), and it is already in use by the locals, at least in Laverton.

With the current state of flux in taxonomy and corresponding nomenclature unstability in Australian elapid snake classification (compare Storr, 1983b and Cogger, 1979), standardised common names will alleviate much of the confusion experienced at present by the layman. Therefore I propose 'spotted mulga snake' as the common name for *Pseudechis butleri.*

Colour variation in *P. butleri:-*

Smith (1982: 43) in his description of this species refers to the pale intrascalar dorsal spotting, basal parts of ventrolateral scales and ventrals as yellow. Glauert (1957: 32) described the lighter parts of a freshly dead specimen assigned to *butleri* by Smith (1982) as 'primrose yellow'. This colouration is typical of specimens examined by me from 46 and 51 kilometres south of Leinster, and from Kookynie. Recently Brad Maryan and I collected an aberrant adult female from the Leonora rubbish tip (28°53'S, 121° 20'E) on 29 September, 1985. This locality is situated about halfway between the northern and southern localities mentioned above from where typical specimens have been observed. The ventral and subcaudal counts of this snake reflect the means given by Smith for this species (means in brackets): ventrals 211 (211.4), subcaudals 60 (59.6).

This specimen is typically black with dark reddish-brown intrascalar dorsal spotting and brown to bluish-grey ventrolateral scales. The belly is off-white or creamish with the anterior edge of each ventral black. Although Smith (*supra. cit.*) refers to the dorsal spotting as ' . . . . yellow (rarely brownish)' he does not mention any variation from yellow in the ventrolateral scales or ventrals in the series of specimens lodged in the WAM examined by him.

It is interesting to note that the greyish-blue ventrolateral colour tends towards the Blue-bellied Black Snake (*P. guttatus*), a congener of similarly restricted distribution in New South Wales and Queensland, however *P. butleri* is distinguishable from it on geographic distribution (western v. eastern) and number of midbody scale rows (17 v. 19).

How widespread the above colour variant of *P. butleri* is will not be known until more similarly coloured specimens are collected, however to date it appears to be rare.

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SOME UNUSUAL FOOD ITEMS FOR THE SOUTHERN BLOTCHED BLUE-TONGUE LIZARD *TILIQUA NIGROLUTEA* (QUOY AND GAIMARD) AT BOMBALA, NEW SOUTH WALES.

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INTRODUCTION

The southern blotched blue-tongue lizard *Tiliqua nigrolutea* (Quoy and Gaimard) is a large omnivorous scincid lizard of montane south-eastern Australia (Cogger, 1983; Jenkins and Bartell, 1980). While numerous food items have been recorded for its congener *Tiliqua scincoides* (Shaw) and the closely related *Trachydosaurus rugosus* Gray (Cogger, 1983; Jenkins and Bartell, 1980; Satrawaha and Bull, 1981; Shea 1980, 1981, 1982; Shugg, 1983; Symon (1979); Worrell 1970) few records of food intake of either wild or captive *T. nigrolutea* exist. Jenkins and Bartell (1980) list insects, snails, slugs, small vertebrates and a wide range of vegetable matter while mice and frogs are sometimes taken in captivity (Shea, 1982). Green and McGarvie (1971) found the remains of a moth, beetles and the wing feather of a small bird in a *T. nigrolutea* stomach. Unidentified fungi have also been reported in their diet (Lucas and Frost 1894, Lucas and Le Souef 1909).

During December 1983 four freshly killed *T. nigrolutea* were collected from roads at Bombala, New South Wales. Specimens were dissected and their stomach contents and reproductive systems examined.

OBSERVATIONS

Locality and biological data on the four road-killed *T. nigrolutea* are presented in Table 1. All four specimens were adults, 3 male and 1 female (snout-vent length 255-320 mm). Good items were recorded from the stomachs of all 4 specimens (Table 1). Two stomachs were intact (specimens 2 and 3, Table 1) and of similar size; the other two were partly macerated but still clearly discernible. Beetles, particularly Scarabaeidae, were the most common food item, occurring in 3 of the 4 stomachs. Specimen 2 contained the greatest volume and variety of food with items representing several invertebrate groups including ants, spiders, slugs, cockroaches and moth larvae. Other, more unusual, items included a small stone, the rubber tyre from a toy car, seeds, grass fragments and fungi. Four species of fungi were found in the stomach of specimen 2 (two agaries *Clitocybe sp.* and *Pholita* sp., and two gasteroid fungi *Setchelliogaster* sp. and *Zelleromyces* sp., while the entire volume of the stomach of specimen 3 was the macerated fruiting body of an unidentified bolete.

DISCUSSION

OMNIVORY IN TILIQUA

Food items have been recorded for 4 of the 9 recognised *Tiliqua* (Cogger *et al.* 1983) and of *Trachydosorus rugosus* (Table 2). While many records are for capture animals, the items taken may give some indication of food taken in the wild. At worst, these captive records suggest a diverse diet. *Tiliqua gerrardii, T. nigrolutea, T. scincoides* and *Trachydosaurus rugosus* all appear to be omnivorous, while *adelaidensis* is largely insectivorous (Ehmann 1982), The smaller size, more agile body form and behaviour of *T. branchialis, T. casuarinae* and *T. maxima* indicates that they may also be largely insectivorous though no food records are available. *T. gerrardii* appears to be intermediate in form between the large, squat species *(T. multifasciata, T. nigrolutea, T. occipitalis, T. scincoides)* and the smaller, more slender species *(T. branchialis, T. casuarinae, T. maxima).* Its food habits in captivity are well documented; taking both small invertebrates and a variety of household food items (Table 2).

Satrawaha and Bull (1981) suggest that the omnivorous diet of *Trachydosaurus rugosus* has reduced their home range size relative to similar sized carnivorous lizards (Turner *et al.* 1969). Conceivably the squat body form and limited mobility have evolved along with the shift towards an omnivorous diet.

DISPERSAL OF SEED AND FUNGAL SPORES?

No data are available on viability of seed and fungal spores after passage through the intestinal tract of *T. nigrolutea.* However, the presence of seed and whole fungal fruiting bodies suggest that *T. nigrolutea* may act as a dispersal agent.

The inclusion of seed and flower heads in the diet of other species of *Tiliqua* and *Trachydosaurus rugosus* (Cogger, 1983; Ehman 1982; Satrawaha and Bull, 1981; Shea, 1982; Shugg, 1983; Worrell, 1970) suggests that these species may also aid seed dispersal. Symon (1979) suggests that large lizards such as *T. scincoides* and *T. rugosus* may feed on fallen ripe fruit of *Solanum simile* F. Muell. in central Australia. Studies overseas (see Iverson 1985 and Van der Pijl (1976)) have shown high and sometimes enhanced seed viability after passage through the intestinal tract of several tortoises and iguanid lizards. The only evidence for viable seed dispersal by Australian reptiles is for the eastern water dragon *Physignathus lesueurii* (Gray) (Clifford and Hamley, 1982) and the land mullet *Egernia major* (Gray) (Conran 1983) though seeds (as whole fruits) have been recorded in the diet of some agamid lizards (Symon, 1979) chelid turtles (Legler 1976) and the scincid lizards *Sphenomorphus tympanum* and *Pseudemoia spenceri* (Webb in prep.).

Three *Tiliqua (T. nigrolutea, T. occipitalis, T. scincoides)* and *Trachydosaurus rugosus* have all been reported feeding on fungi (Table 2). However, except for the observation of Serventy (1970) of a *T. rugosus* feeding on a bolete fungus these fungi remain unknown and, in some cases, it is not clear whether these fungi were eaten in the wild or fed to lizards in captivity. The fact that *T. nigrolutea* eats fungi in the wild is now demonstrated. The presence of fungi in two of the four stomachs also suggests that fungi, when in season, may be a common food of *T. nigrolutea.* Whether fungal spores survive the passage through the intestinal tract of *T. nigrolutea* and germinate remains to the determined. This seems likely, however, since other small animals (Fogel and Trappe 1978, Trappe and Maser 1976) are known to disperse viable fungal spores after consuming fruiting bodies.

Further studies involving collection and culture of faeces from wild lizards or experimental feeding trials with captive lizards may show whether large omnivorous lizards like *Tiliqua* and *Trachydosaurus* are effective seed and fungal spore dispersal agents.

ACKNOWLEDGEMENTS

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Table 1: Locality and biological data for road-killed *Tiliqua nigrolutea* at Bombala. Stomach dimensions are given where possible.

Specimen No.	Date	Location	Sex	Body Length (snout to vent) (mm)	Reproductive Status	Stomach Contents		
							Prey items	
1	15 Dec. 1983	Bondi State Forest Camp on gravel road through grazing land (37°09'S, 149°09'E)	♀	295	largest egg in R.H. ovary = 6mm	Beetles	*Anoplognathus* sp. 1	1 x 22mm
							Anoplognathus sp. 2	1 x 22mm
							Passalidae	1 x 18mm
							Beetle elytra	1 x 10mm
						Others	stone	1 x 5mm
2	15 Dec. 1983	Mila. On bitumen road through grazing land (37°03'S, 149°10'E)	♂	290	R.H. testis length = 20mm	Beetles	Scarabaeidae	1 x 10mm
							Scarabaeidae abdomen (probably Melolonthinae)	1 x 12mm
							Scarabaeidae abdomen (probably large *Anoplognathus*)	1 x 10mm
							Beetle prothorax (prob. Tenbrionidae)	1 x 3mm
						Others	Ant head	1 x 2mm
							Spider chelicerae	2 x 2mm
							Cockroach abdomen	1 x 5mm
							Moth (Noctuidae) larvae	66 x (10-35mm)
							seeds	2 x 4mm
							grass fragments	numerous
							fungi (4 species)	
							Stomach enlarged.	85 x 30mm
3	19 Dec. 1983	Coolangubra S.F. on gravel road through logged tall open forest (36°58'S, 149°23'E)	♂	320	R.H. testis length = 22mm		Large volume of fungi and grass pieces. Stomach enlarged.	(80 x 27mm)
4	20 Dec. 1983	Bombala. On bitumen road in town centre (36°55'S, 149°14'E)	♂	255	R.H. testis length = 20mm		Slug	1 x 32mm
							beetle fragments (prob. Scarabaeidae)	numerous
							rubber tyre from toy car	1 x 15mm

Table 2: Summary of biological data on *Tiliqua* spp. and *Trachydosaurus rugosus.*

	Distribution	Habitat	Food
Tiliqua adelaidensis (Peters)	S.E. South Australia	Mallee	ants, grasshoppers, spiders, cockroaches, beetles, crickets, small amount of vegetable matter and seeds. (Ehmann 1982)
Tiliqua gerrardii (Gray)	Eastern N.S.W. and Qld.	Wet sclerophyll and rain forests	arthropods (Cogger 1983) (In captivity) slugs, snails, insects, crickets, cockroaches, mice, banana, tinned pet food, raw meat, milk. (Field 1980, Longley 1938, Shea 1982, Stephenson 1977, Wilhoft 1960)
Tiliqua nigrolutea (Quoy and Gaimard)	Vic., S.E. N.S.W., Tas.	Variety of highland and southern coastal habitats	insects, snails, slugs, small vertebrates, wide range of vegetable matter (Jenkins and Bartell 1980) (In Wild) Moths, beetles feather of small bird? (Green and McGarvie 1971) Fungi (Lucas and Frost 1894, Lucas and Le Souef 1909) (In captivity) mice, frogs (Shea 1982)
Tiliqua occipitalis (Peters)	W.A., S.A., N.T., western N.S.W., Vic.	Desert and semi-arid habitats *(Triodia/* Mallee)	Fungi (Dell and Chapman 1979)
Tiliqua scincoides (Shaw)	Eastern and central Australia to north-western Kimberly region	Wide variety of habitats	arthropods, snails carrion, flowers, native fruits, and berries (Cogger 1983) Insects, snails wide range of vegetable matter (Jenkins and Bartell 1980) snails, insects, fruit, (Worrell 1970) Fungi (Gunther 1867, Gregory and Lucas 1886) (In wild), snails, dogs faece, vegetable matter including dandelion flowers, lantana leaves clover, apple scraps. (Shea 1982)

			(In captivity) mice, frogs, small lizards tinned pet food (Shea 1981, 1982).
Trachydosaurus rugosus Gray	Southern and eastern Australia	Desert and semi-arid habitats	arthropods, snails carrion, flowers, fruits and berries (Cogger 1983)
			invertebrates, vegetable matter (Jenkins and Bartell 1980)
			fungi (Anon 1892, Brazenor 1936, Hyett 1961, Kershaw 1927, Serventy 1970, Waite 1925)
			snails, insects, fruit, blossoms and other vegetable matter (Worrell 1970)
			(In captivity) banana, tinned pet food (Shea 1980)
			Strawberries, tomatoes (Symons 1979)
			(In wild) snails, beetles, carrion, flower heads, seeds, and berries, and other plant material (Satrawaha and Bull 1981)
			(In wild) *Patersonia* flower heads (Shugg 1983)

A COMPARISON OF THE GROUND-DWELLING VERTEBRATE FAUNAS FOUND IN HUMMOCK GRASSLAND AND MULGA SHRUBLAND IN CENTRAL AUSTRALIA.

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INTRODUCTION

In the Australian arid zone, much of the area is covered by two vegetation types; *Acacia spp* shrublands and woodlands (33%) and hummock grasslands (31%) (Morton, 1982). Australian deserts are considered to be species rich in reptile and insectivorous mammalian species (Pianka, 1969; Heatwole and Butler, 1981; Morton, 1982). Cogger

(cited in Heatwole, 1976) suggests that at least part of the reason for this high diversity in lizards is due to the presence of hummock grasses. Morton (1982) suggests that *Acacia* shrublands are depauperate in small insectivorous mammals when compared to hummock grasslands and that the species richness of small mammals in hummock grasslands is paralleled only by lizard species in that same habitat.

In an endeavour to investigate the properties of each of the two habitats in relation to small ground-dwelling vertebrates, a trapping exercise was performed in Central Australia.

METHODS

Small mammals and reptiles were captured using a pit-fall trapping technique in conjunction with drift fences in a hummock grassland *(Triodia pungens)* site and a mulga *(Acacia aneura/A. ayersiana)* shrubland site, approximately 12 km north-east of Ayers Rock, Northern Territory (Lat 25°16'S; Long 131°09'E).

The two sites were approximately 100 metres apart with the habitat interface 50 metres from each site, along an old road. The lines of pits were perpendicular to this road.

Each site contained 10 pit-fall traps, each 3 metres apart. A continuous drift fence, 30 metres long, passed over the diameter of each pit, so that all 10 pits were covered by one fence.

Bulk flour tins were used, as pits. They were sunk into the ground so that the lip was at ground level. Each pit was 40 cm deep and 30 cm in diameter.

It is possible that some mammal species were able to escape pits by jumping; however this does not seem to have happened. The traps were adequate for all reptile species encountered, although larger snakes known to occur in the area were not caught. Tracks in the sand around the trap sites did not indicate the presence of any species not recorded in the pits.

Predation from the traps did not occur, however one instance of predation within the traps did occur *(Sminthopsis ooldea* devoured one half of an *Amphibolurus isolepis)*.

Trapping was carried out continuously from 5 August 1981 to 13 October 1981, a period of 69 days. Traps were checked each morning at 08.00 hours.

RESULTS

Table 1 shows the species recorded from each site and the numbers of each species caught.

Table 1: Species and numbers of mammals and reptiles captured in hummock grassland and mulga shrubland sites.

SPECIES	Hummock grassland	Mulga shrubland
Mammals		
Mus musculus	3	1
Notomys alexis	3	–
Pseudomys hermannsburgensis	18	–
Ningaui ridei	6	–
Sminthopsis ooldea	1	1
Reptiles		
Diplodactylus ciliaris	3	1
D. conspicillatus	4	2
D. elderi	2	–
Nephrurus levis	1	–
Rhynchoedura ornata	2	2
Delma borea	4	–

D. nasuta		9	–
Lialis burtonis		1	–
Amphibolurus isolepis		23	–
A. mitchelli		2	1
Varanus eremius		1	–
V. gouldii flavirufus		1	–
Ctenotus calurus		3	–
C. dux		3	–
C. leonhardii		–	9
C. pantherinus		25	–
C. piankai		3	–
C. quattuordecimlineatus		7	–
C. schomburgkii		–	1
Lerista desertorum		–	1
Pseudonaja modesta		2	–
TOTAL SPECIES 26	Total numbers	127	19

Hummock species	23 (86%)
Mulga species	9 (34%)
Shared species	6 (23%)

From table 1 it is clear that the hummock grassland site supports a much more diverse and numerous ground-dwelling vertebrate fauna than the mulga shrubland.

It has been stated that the physical form of hummock grasses creates a more favourable and stable microclimate inside the clump which enables more species to survive in an arid area than would otherwise be possible (Heatwole, 1976; Heatwole and Butler, 1981). To avoid or minimise competition, the species utilizing the stable microclimate of the hummock grasses are believed to have been able to evolve fine specializations or smaller niches so that all species can occupy the same area (Pianka, 1969). This idea conforms to the theory of environmental stability (Krebs, 1972) which states that "the more stable the environmental parameters, the more species will be present" Not only is the microclimate in the hummock grasses stable, but the hummock grassland itself is relatively stable. The *Triodia* and *Plectrachne* species that form the hummocks are persistant plants that do not change in shape or form in changing climatic circumstances. During long droughts they do not wither and blow away like other less robust grasses.

In addition to the favourable microclimate, the hummock grass growth form, consisting of a dense network of outward facing, sharp needles, provides an ideal shelter from predators.

These advantages of hummock grasses are also utilized by many invertebrate species. Small animals can hunt with relative ease inside the grass hummock, so small insectivorous animals living within a grass hummock can utilize a food resource within their own shelter site.

The above features of hummock grasses are in marked contrast to the open shade, scattered shrubs and grasses and limited good shelter sites available in mulga shrubland. The mulga shrubland is a floristically and structurally more diverse habitat than hummock grassland. The greater structural heterogenity favours birds, and arboreal animals and bats can shelter beneath loose bark or in tree hollows. Large animals that are too big to shelter in grass hummocks, utilize the mulga for shelter. At ground level there are large open spaces between trees which may be bare, lightly grassed or covered by fallen branches or leaf litter. The only shelter sites available for ground-dwelling vertebrates are holes in the ground around the bases of trees, fallen branches and bark, in grass tussocks or under leaf litter. Movement away from these refugia places an animal in the open and liable to predation.

Another factor which could contribute to the observed differences are the soil characteristics of the sites. The hummock grassland site is on red silicaceous sands which drain well after heavy rains. The mulga shrubland is on a red earthy sand which is relatively compacted and which holds water for longer periods after heavy rains (Hooper

et al, 1973). Burrowing animals probably find it easier to dig in the sandy soil of the hummock grassland site, and do not face the same risks of flooding that they would in the mulga site.

The low number of species shared between the two sites (23%), indicates that the communities in each habitat are quite different. 66% of the species occuring in the mulga site are also found in the hummock grassland site. Possibly, these species are "generalist" type animals that can survive in a wide range of habitats. The 34% of species restricted to the mulga site may have some adaptions that enable them to survive in that habitat but prevent them from moving into the hummock grassland. Only 26% of the hummock grassland species are also found in the mulga site; possibly indicating that the "specializations" of the remaining 74% do not allow them to live in the less stable, more diverse mulga site.

Many factors are interacting to give the observed results. Micro-climate conditions, shelter availability, food availability, predation and substrate characteristics are factors which influence the distribution of any species in any area. In this case the stable nature of the hummock grassland and it's sandy soil, seem to be advantageous to more of the small ground-dwelling vertebrate species than the more erratic and diverse conditions in the mulga shrubland.

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HERPETOLOGICAL NOTES

PREDATION ON CANE TOADS *(Bufo marinus)*

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For two years I have noticed several desiccated, disembowelled corpses of Cane Toads under roosting trees and on fence posts but until recently was unsure of which animals were responsible. The other day however I witnessed a pied currawong *(Strepera graculina)* in the act of consuming a toad. The bird was holding the toad, upside down, on a fence

post whilst it inserted its beak into the body by a slit it had made between the toads rear legs.

When I collected the corpse it resembled all the others I have seen in that it was devoid of the internal organs, muscle tissue, front legs and chin flesh.

Cane Toads have been in the area for over ten years and their population fluctuates from year to year. Some years ago I observed hundreds in my back yard in the early evening but at the moment there seem to be relatively few – perhaps due to the excessive rain which may have helped to flush the tadpoles from the water bodies.

I realise that the birds cannot be considered an effective control against Cane toads but I thought my observation may be of interest. Unfortunately I have not yet observed how the birds manage to kill the toads and avoid the toxic secretion.

CAPTIVE BREEDING OF *UNECHIS FLAGELLUM.*

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INTRODUCTION

Unechis flagellum is a small (0.4m) terrestrial and chiefly nocturnal snake. It is distributed through central and coastal Victoria into southern New South Wales and south-eastern South Australia.

In August 1982 some specimens of *U. flagellum* were collected from rocky outcrops in Bundoora (37°45'S. 144°58'E.).

METHODS

The specimens (3 female and 2 males) were housed in an indoor cage measuring 100 x 50 x 50cm. A temperature gradient was designed to mirror, within limits, the natural temperatures of the area.

Conditions were maintained as follows:

November - May:	day-time temperature range 26-34°C.
	night-time temperature range 5-20°C.
	photoperiod 16 hours daylight, 8 hours darkness.
June - October:	day-time temperature range less than 22°C.
	night-time temperature range less than 22°C.
	photoperiod 12 hours daylight, 12 hours darkness.

The temperatures and photoperiods were achieved gradually and not just switched from one to another.

In addition to the five specimens two other male *U. flagellum* were kept seperately and used on a rotational basis.

COPULATION AND BIRTH

Early in October 1982 copulation was observed on two separate occasions each involving different pairs. In late February two broods of six and four were born.

The following year mating was again observed in early October. Pairs were joined for between 4-6 hours (± 30 mins). One female gave birth to four young after 151 days while another had only two young after 148 days. These latter two were marginally larger and stouter in build. The third female also produced two young which were enveloped in membraneous sacs.

Prior to giving birth the females had a distinct affinity for warmth. This involved basking during daylight hours directly below the heat source. This continued throughout the entire course of gestation, ending abruptly with the birth of the young.

JUVENILES

Juveniles were exact replicas of adults. At birth they seemed identically marked, however colour variations became more pronounced with age. Sloughing took place seven days after birth, and prior to this they commenced feeding on small skinks. Total lengths ranged from 120-140mm ($\bar{x}$ = 135mm) and snout-vent lengths varied between 106-125mm ($\bar{x}$ = 115mm).

DISCUSSION

The brood sizes and length of juveniles at birth correlates with that recorded by Fyfe (1980) who noted a brood of four with juveniles measuring 140mm. However the gestation period he reported was 108 days compared with 148-151 days from this study. I believe the temperature gradient was an influencing factor, with Fyfe maintaining a more constant heat.

The reproductive data make an interesting comparison with Jenkins & Bartell (1980) who state that 'juveniles measure approximately 70 to 80mm at birth'.

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AN ALTERNATIVE METHOD FOR RECORDING THE SCALATION OF SNAKES.

P. Orange, 2 Kurrajong Lane, Kambalda, W.A. 6442.

Some time ago I was attempting to record the scalation of a live *Vermicella bimaculata*. I had managed to count the number of midbody scales and subcaudals but was having trouble counting the ventrals. The snake's small size and constant movements were making it impossible to count the ventrals with any accuracy so I decide to try photocopying the snake. I carefully positioned the snake, ventral surface down, on the photocopier and gently lowered the lid. The snake was then photocopied in the normal manner.

As can be seen from Figure 1 the results are surprisingly good, enabling the ventrals to be counted with ease. As it is the ventrals, in my opinion, that are the hardest scales to count, this technique works well. With some snakes the subcaudals can also be counted from the photocopy, although with small thin snakes the subcaudals are often indistinct on the copy and become hard to count.

This method of recording the scalation of snakes does of course have its limitations. With very small, thin snakes (such as some *Ramphotyphlops* species) the photocopier cannot reproduce the scalation satisfactorily. At the other end of the scale, large snakes can also pose problems. The snake may be too large for the photocopier or its bulk may prevent the proper closure of the copier lid. To date I have successfully photocopied snakes ranging in size from a *Vermicella bertholdi* (total length 199mm), to a *Pseudonaja modesta* (total length 468mm).

When photocopying snakes, care must be taken to ensure that the snake is not harmed in any way. None of the live snakes I have photocopied to date have come to any apparent harm. Perhaps the most obvious danger is that of the lid of the photocopier being too heavy for the snake and squashing or damaging it internally. If I feel there is a risk of this occurring, I rest the lid of the photocopier on my finger, so that the full weight does not rest on the snake.

Another problem could be that of the snake overheating due to the heat from the copier. Care should be exercised when taking several photocopies of the same snake to make sure the snake is not overheated.

The only other problem facing those wishing to try this method of recording scalation is where to photocopy their snakes. I am lucky in that I can use a privately-owned photocopier. Others may not be so fortunate. Most libraries have photocopiers, but some librarians may hold rather a dim view of people wanting to photocopy snakes.

I generally reserve this method of recording snake scalation to live specimens that I do not wish to retain in captivity. If I am going to keep the snake over a period of time, chances are it will slough, in which case I can use the slough to count the ventrals, subcaudals, etc. If the snake is dead or is to be killed for preservation, then recording the scalation poses few problems.

I have found this technique to be a vast improvement on trying to hold an agitated snake still enough to count its ventrals. I hope others will find this method just as useful.

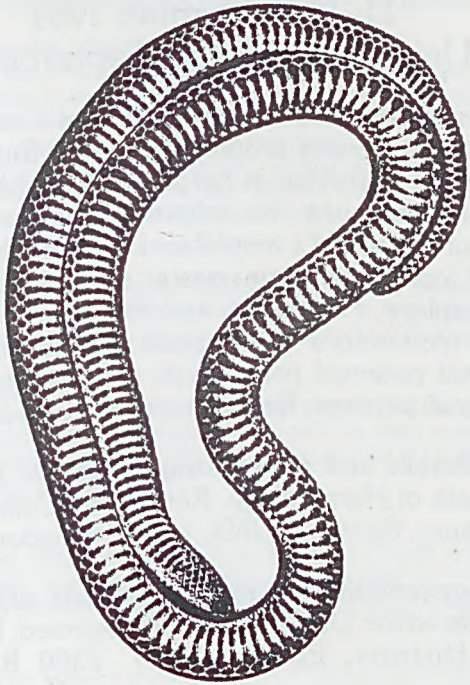

Figure 1. A photocopy of a live *Vermicella bimaculata*. This was the snake I photocopied. As can be seen, the copy is clear enough for the ventrals and subsaudals to be counted.

The World Congress of Herpetology announces the

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